# WAYNE COUNTY SOLID WASTE MANAGEMENT STUDY: PRELIMINARY REPORT TO LOCAL OFFICIALS

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## Introduction

Wayne County[1/] like many rural counties in the U. S. has experienced an increase in roadside dumping, particularly since the passage of Solid Waste Disposal and Anti-Stream Dumping Laws in 1967 [20]. This legislation resulted in the closing of over 1300 Ohio township open dumps (including 14 open dumps in Wayne County) and in the establishment of one or more sanitary landfills per county. Increases in travel time to and user charges at the sanitary landfills has made legal solid waste disposal much more costly for many rural residents. The resulting increased roadside dumping is unsanitary and is a form of sight pollution. It also imposes economic costs on residents. Local officials have reported some evidence of increased maintenance cost of roadside mowing and ditching machines due to increased roadside litter. An effort to pick up the roadside litter resulted in annual equipment and labor costs of $32.00 per mile on the Wayne County roads where the clean-up operation was conducted. In response to these problems, bulk box pilot projects were implemented in three rural townships of Wayne County [15].

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1/ Wayne County is located in Northeast Ohio about 50 miles south of Cleveland and covers 551 square miles. Of the county's 1970 population of 87,123, 37.2 percent resided in the three cities of Wooster, Orrville, and Rittman, 14.8 percent lived on farms, 34.8 percent were classified as rural non-farm and 13.8 percent were residents of the 12 incorporated villages in the county.

Several other aspects of the solid waste situation in Wayne County make it both somewhat unique and problematic, The two major operating landfills located north of Wooster and in the Mt. Eaton area, have limited capacity remaining. The landfill north of Wooster is currently cited by Ohio EPA for several violations regarding daily cover, compaction, and leachates. The city of Wooster is concerned about the possibility of leachate from the Wooster Disposal Landfill polluting the city's water supply. The Mt. Eaton area landfill is located in an old strip mine several miles from the county's population center. Management problems are evident and its operators complain of inadequate volume to make it a feasible operation. Finally, the city of Orrville has given some consideration to burning solid waste for steam generation and has retained a consulting engineer to do some preliminary feasibility work on this concept.

The overall objective of this study was to utilize a systems approach to help local officials develop a feasible solid waste management plan for Wayne County, Ohio. The specific objectives included the following:

1. To get reliable estimates of the amount of solid waste generated from household, commercial, and industrial sources in Wayne County and project future amounts.

2. To inventory the type, number, capacity, and public and private costs of current collection, storage, and disposal facilities and practices in Wayne County.

3. To do a cost-effectiveness analysis of alternative storage, collection, disposal and recovery systems for Wayne County.

4. To identify a least cost solid waste management system for collecting, storing, disposing of and/or recovering Wayne County's solid waste in an environmentally acceptable manner.

## Solid Waste Generation

### Current Generation

Getting reliable measures of the actual and projected amounts of solid waste generated in Wayne County was considered a major study objective. Without this information, it becomes extremely difficult to evaluate alternative technologies and plans for solid waste collection, storage, disposal and/or recovery. An obvious difficulty is the determination of equipment and total system capacity without adequate estimates of waste generation. Many prior studies have used relatively rough rules-of-thumb on waste generation that have become increasingly suspect with the rapidly changing resource recovery situation, anti-throwaway legislation, etc.

The decision to get reliable waste generation estimates resulted in considerably more work than had been anticipated. First, waste generation was divided into four major types by source: (1) residential, (2) commercial, (3) industrial and (4) institutional. Different activating procedures were developed for each of these major sources. Secondly, a decision was made to net out the amount of solid waste potentially available for disposal and/or recovery from the total amount of solid waste generated in the county. This was done primarily to avoid inclusion of solid waste that was already being sold, recycled or disposed of on the premises of individual industries.

Considerable work has been done on residential waste generation in incorporated areas [1]. Based on these previous studies, an estimate of 2.3 pounds/person/day was adopted for residential solid waste in incorporated

areas of Wayne County. Data from the earlier "green box" pilot project in Wayne County [15] were compared with estimates from the U.S. Environmental Protection Agency [11] to arrive at an estimate of 1.5 pounds/person/day for residential solid waste generated in unincorporated areas of Wayne County.

Commercial firms include the retail, wholesale and service businesses within the county. A sample ranging from 9 to 16 percent was drawn from each of these major types of commercial firms and interviews were conducted. Based on the volume of solid waste/employee determined from this sample survey, an estimate was made for the remainder of the commercial firms in Wayne County by type of firm and number of employees.

An early attempt at determining the amount and type of industrial solid waste in Wayne County by comparing U.S. EPA coefficients [23] with a sample of Wayne County industries was not considered reliable. Even within specific types of industries wide variation existed between the observations sampled. Accordingly, over 100 industries (defined as all the manufacturing firms) in Wayne County were contacted personally or by phone to secure information on the type and volume of solid waste generated. Any solid waste that was being sold, recycled or disposed of on the premises of any given industry, was netted out of the final estimates.

Institutions such as schools and hospitals were surveyed regarding the amount of solid waste generated from this source in Wayne County. All of the unique institutions were contacted and a sample of primary and secondary schools was used to estimate the total solid waste generated by this institutional source. Table 1 summarizes the current (1974)

TABLE 1

CURRENT WAYNE COUNTY SOLID WASTE GENERATION BY TYPE AND SOURCE POINT IN TONS/DAY, 1974

| Source Points [a] | Types of Solid Waste (Tons/Day) | | | |
|---|---|---|---|---|
| | Residential | Commercial [b] | Industrial | Total |
| Apple Creek (V) | 1.05 | 2.72 | --- | 3.77 |
| Burbank (V) | 0.48 | 0.21 | --- | 0.69 |
| Congress (V) | 0.28 | 0.12 | --- | 0.40 |
| Creston (V) | 2.19 | 0.98 | --- | 3.17 |
| Dalton (V) | 0.75 | 1.08 | 0.03 | 1.86 |
| Doylestown (V) | 3.18 | 1.42 | --- | 4.60 |
| Fredericksburg (V) | 0.81 | 0.36 | --- | 1.17 |
| Marshallville (V) | 0.93 | 0.41 | --- | 1.34 |
| Mt. Eaton (V) | 0.32 | 0.14 | 0.05 | 0.51 |
| Orrville (C) | 9.94 | 3.53 | 57.02 | 70.49 |
| Rittman (C) | 8.48 | 2.33 | 29.75 | 40.56 |
| Shreve (V) | 2.19 | 0.98 | 0.18 | 3.35 |
| Smithville (V) | 1.71 | 0.77 | 0.11 | 2.59 |
| West Salem (V) | 1.42 | 0.64 | 0.04 | 2.10 |
| Wooster (C) | 25.09 | 20.20 | 54.95 | 100.24 |
| Baughman (T) | 2.01 | --- | --- | 2.01 |
| Canaan (T) | 1.51 | 0.58 | --- | 2.09 |
| Chester (T) | 1.92 | --- | --- | 1.92 |
| Chippewa (T) | 4.24 | 0.52 | --- | 4.76 |
| Clinton (T) | 1.05 | --- | --- | 1.05 |
| Congress (T) | 1.24 | 0.43 | --- | 1.67 |
| East Union (T) | 4.88 | 0.56 | --- | 5.44 |
| Franklin (T) | 1.94 | --- | --- | 1.94 |
| Green (T) | 2.15 | 0.48 | --- | 2.63 |
| Milton (T) | 2.23 | --- | --- | 2.23 |
| Paint (T) | 1.36 | --- | --- | 1.36 |
| Plain (T) | 1.76 | --- | --- | 1.76 |
| Salt Creek (T) | 1.30 | --- | --- | 1.30 |
| Sugar Creek (T) | 3.72 | --- | --- | 3.72 |
| Wayne (T) | 3.15 | --- | --- | 3.15 |
| Wooster (T) | 3.40 | 0.67 | --- | 4.07 |
| TOTAL | 96.68 | 39.13 | 142.13 | 277.94 |

[a] V = village; C = city; T = township.

[b] Includes institutional solid waste.

solid waste generation estimates by type for each source point (city, village, or township) in Wayne County.

Future Generation

Projecting current (1974) solid waste generation to future time periods proved to be extremely difficult. A decision was made to attempt projections for 1980, 1990, and 2000 primarily to facilitate planning for adequate system capacity over time. It also became evident that different projection methodologies were needed for the various types of solid waste sources. In general, future amounts of residential, commercial, and institutional solid waste appear to be a function primarily of county population changes over time. Alternatively, future amounts of industrial solid waste would appear to be more related to changes in county employment over time.

Several previous studies [2,3,17,18,25] have attempted to estimate future solid waste generation. Typically, the authors have assumed that per capita generation of solid waste will continue to increase over time. Multiplying these increasing waste generation coefficients times various population projections has resulted in some phenomenal futuristic estimates of solid waste generation. The key question is whether or not solid waste generation per capita (or per employee) will continue to increase in the future as it has in previous periods, particularly prior to 1973?

The resource recovery implications of the so-called "energy crisis" and emerging anti-throwaway legislation (e.g., The Oregon Bottle Law)

are developments that would appear to work against further increases in per capita generation of solid waste. Burning combustible solid waste for generation of electricity and the sale of recovered ferrous metals are already economic realities. The possibilities for further development in these areas look very promising [1,24]. The waste generation survey of industry in Wayne County during this past summer also revealed a surprising amount of resource recovery (recycling of paper, sale of scrap iron, etc.) already in operation. For these reasons, constant (based on 1974 values) waste generation coefficients are assumed for the projections to 1980, 1990, and 2000.

The residential, commercial, institutional and industrial solid waste generation projections for Wayne County are based primarily on population and employment projections developed by the Ohio Department of Economic and Community Development for a five-county area including Wayne, Stark, Summit, Portage, and Medina [22]. The DECD projections for Wayne County were based on average population and employment projections for the aforementioned five county area. Accordingly, it was necessary to "adjust" these projections based on the degree to which Wayne County's previous population and employment growth rates had deviated from the rates for the five county area. Table 2 presents the summary of the Wayne County solid waste generation current estimates and projections by type (in tons/day) for 1974, 1980, 1990, and 2000.

As illustrated in Table 2, solid waste generation in Wayne County is expected to increase from 277.94 tons/day in 1974, to 548.48 tons/day in 2000. Much of the increase from industrial sources is projected by 1980

TABLE 2

SOLID WASTE GENERATION ESTIMATES AND PROJECTIONS
FOR WAYNE COUNTY, OHIO, 1974, 1980, 1990, 2000

| | Tons/Day | | | |
|---|---|---|---|---|
| Source | 1974 | 1980 | 1990 | 2000 |
| Residential | 96.68 | 110.48 | 124.48 | 137.48 |
| Commercial* | 39.13 | 55.00 | 61.00 | 66.00 |
| Industrial | 142.13 | 316.00 | 338.00 | 345.00 |
| TOTALS | 277.94 | 481.48 | 523.58 | 548.48 |

*Includes institutional solid waste.

due to a relatively large projected growth in employment in Wayne County through 1980 and a projected leveling off in employment from 1980 to 2000. The current recession is not reflected in these employment projections. Thus, the projected solid waste generation from industry in Wayne County (particularly for 1980) may be biased upward.

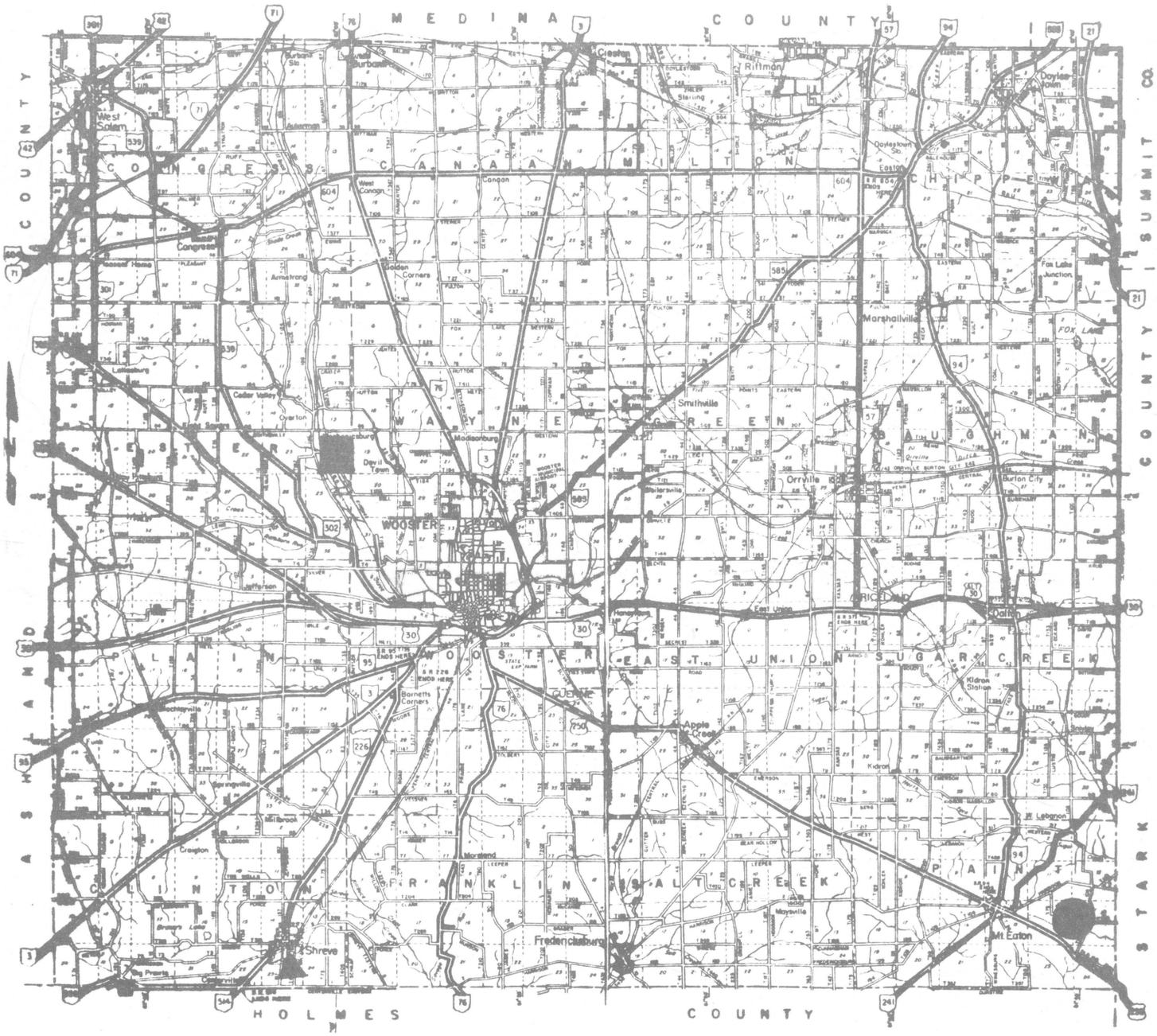
## Current Facilities, Equipment, and Practices

### Sanitary Landfills

There are currently three sanitary landfills operating in Wayne County (see Figure 1). Wooster Landfill is located five miles northwest of the City of Wooster and is owned and operated by Wooster Disposal Incorporated. Mt. Eaton, Phase III or Twilight Mining Landfill is located 2.6 miles east of Mt. Eaton and is owned by Twilight Mining Incorporated and operated by Atlee Mullet. The Shreve Sanitary Landfill is owned and operated by the Village of Shreve and serves primarily the residents of the village and surrounding Clinton townships.

All three of these sanitary landfills have experienced some problems in terms of improper cover, leachates, etc. Wooster Landfill was recently cited by Ohio EPA for several violations (see Appendix B). The Shreve Landfill is only open two days per month and serves a rather limited area. Both the Wooster and Mt. Eaton, Phase III landfills have limited remaining capacity. Size, diseconomies from inadequate volume, and legal problems of the Mt. Eaton Landfill operator add considerable uncertainty to his future operation. An additional site (Phase II) in the Mt. Eaton area has been approved and could be developed as another alternative for landfilling.

Figure 1. Current Landfill Sites, Wayne County, 1974




▲ - Shreve Sanitary Landfill

■ - Twilight Mining Landfill (Mt. Eaton)

● - Wooster Disposal Landfill Incorporated

Mr. Bob Dush, Wayne County Soil Conservation Service, Mr. Robert Shrock, County Sanitarian, and Mr. Chuck Mann, a private consulting engineer were asked to make independent estimates on the area, capacity, and remaining life of Wooster and Mt. Eaton Phase III and II landfills. A meeting was held to compare their estimates and to arrive at a reasonable compromise. The estimates in Table 3 were developed from the foregoing investigations and meeting.

An inventory of the equipment currently being utilized at the three operating sanitary landfills includes:

1. Wooster Landfill
    a. 1 -- 1971 250 International loader on tracks with 4 cu. yd. bucket
    b. 1 -- 1972 Huff 90 loader on rubber with 4.5 cu. yd. bucket
    c. 1 -- 1971 Allis Chalmers scraper
2. Mt. Eaton, Phase III
    a. 2 -- International TD24 bulldozers
    b. 1 -- International TD15 bulldozer
3. Shreve
    a. 1 -- Caterpillar 933 bulldozer
    b. 1 -- backhoe

Collection and Storage

There are currently three major private haulers (Wooster Disposal, Austin Disposal, and Suburban Disposal) and at least seven small (one packer truck) haulers providing solid waste collection in Wayne County.

TABLE 3

ESTIMATED AREA, CAPACITY, AND LIFE OF SANITARY LANDFILLS
IN WAYNE COUNTY, OHIO, NOVEMBER 1974

| | Wooster | Mt. Eaton Phase III | Mt. Eaton Phase II | Shreve |
|---|---|---|---|---|
| Total landfill area (acres) | 150 | 91 | 135 | 4 |
| Area for disposal (acres) | 40 | 25 | 21 | 4 |
| Remaining capacity (tons) | 163,800 | 51,800 | 589,225 | 450 |
| Estimated life (years) | 2-3 | 1 | 6-12* | 10 |

*Depends on whether another sanitary landfill is established in the Northern half of the county after the Wooster landfill has been closed.

The major haulers were willing to provide information on routing patterns (see Figure 2), equipment, etc. However, none of the small private haulers were willing to provide this type of information.

Wooster Disposal operates eight packer trucks out of the city of Wooster. Its routes encompasses the central portion of the county including the city of Wooster, the south-central areas of Wooster and Franklin Townships, the city of Orrville and some of the areas to the south of Orrville, and most of the northwest quarter of the county including the village of Creston. Wooster Disposal has municipal contracts with Wooster, Orrville and Creston and the remainder of their contracts are with individual residents, firms, or industries.

Austin Disposal operates three packer trucks out of Funk and has routes through the southwest townships of Plain and Clinton along the western edge of the county up to and including the village of West Salem, Sugar Creek, West Union, and Green Townships, including the village of Smithville, and areas surrounding the city of Wooster in Wayne and Wooster Townships. Austin has municipal contracts with West Salem and Smithville in addition to individual residential and commercial contracts.

Suburban Disposal operates three packer trucks out of Akron and has routes in northeast Wayne County in the Milton, Chippewa, and Baughman Township areas. Suburban has one municipal contract with the city of Rittman in addition to its individual private contracts. Merle Jackson, one of the small independent private haulers, works out of Marshallville and has municipal contracts with the villages of Marshallville and Doylestown.

Considerable overlap exists in the current private hauler routing patterns. For example, Austin and Wooster Disposal overlap in Congress, Wayne, and Wooster Townships. Additional overlap occurs between these two haulers along the western edge of Wayne County. Excessive overlap results in much higher transport,costs per ton of solid waste collected. Little information was available on six of the seven small private haulers. However, it would appear that some of these small haulers overlap some of the routes of the foregoing major private haulers. They may also be collecting in some areas of low population density which are economically marginal for the major private haulers.

An inventory of the collection equipment utilized by the three major private haulers includes:

1. Wooster Disposal

    a. 4 -- GMC 20 cu. yd. rear load packers
    b. 3 -- IH 20 cu. yd. rear load packers
    c. 1 -- Reo 20 cu. yd. rear load packer
    d. 1 -- IH tandem pull-on
    e. 1 -- Reo tandem pull-on
    f. 1 -- Ford 1 ton truck
    g. 1 -- Chevrolet pick-up

2. Austin Disposal

    a. 1 -- 18 cu. yd. side load packer
    b. 1 -- 20 cu. yd. side load packer
    c. 1 -- 24 cu. yd. side load packer

3. Suburban

    a. 3 -- GMC 20 cu. yd. rear load packers

In addition to the above collection equipment, Wooster Disposal has 3 -- 42 cu. yd. trailers which are coupled with their tandem pull-ons. All three

major private haulers have small bulk boxes, but the exact number and sizes were not determined. Except for the Baughman Township 8 cu. yd. bulk boxes, however, all bulk boxes are being used by industries, commercial firms, and institutions.

## Cost of Current System

The following outline represents an estimate of the monthly cost of solid waste management in Wayne County. The monthly charges for residential customers were obtained from the private haulers in the county along with the approximate number of customers that they service. The amount of residential waste taken directly to the landfills by residents was estimated at 5 percent of the waste going into the landfills.

The cost per month for commercial and industrial waste is an average cost per cubic yard of waste that is charged by the private haulers. Waste that is taken directly to landfills by residents incurs private travel costs and opportunity costs over and above the dumping charge at the landfill. These costs are extremely variable and difficult to calculate. However, in the overall system they become relatively insignificant and therefore were not included here.

I. Residential

Collector A: $2.75/mo. x 4844 customers = $13,321

Collector B:
a) $2.27/mo. x 5000 customers = $11,350
b) $1.75/mo. x 2300 customers = $ 4,025
c) $2.75/mo. x 350 customers = $ 963
d) $3.25/mo. x 4850 customers = $15,763

Collector C: $4.50/mo. x 3545 customers = $15,953
Baughman Township Box System = $374

Estimated Direct Landfill by Residents:

1) Mt. Eaton: 910 yds./mo. x $.50/yd. = $455
2) Wooster Landfill: 618 yds./mo. x $1.00 yd. = $618

Total Residential Cost = $62,446/mo.

II. Commercial*

13,565 cu. yds./mo. at an average cost of $1.97/cu. yd./mo. = $26,723/mo.

*Includes institutional waste.

III. Industrial

36,954 cu. yds./mo. at an average cost of $1.81 cu. yd./mo. = $66,887/mo.

IV. Total cost per month = $156,056 x 12 mo./yr. = $1,872,672/year

## Evaluation of Disposal and Recovery Alternatives

To assist in evaluating the various old and new solid waste disposal and recovery alternatives in Wayne County, a ton-mile transport matrix was developed (see Table 4). Distances in road miles were calculated from each of the source points to each of the possible disposal or recovery points. Source points were considered to be the cities, villages, and townships without a city or village. Waste generation estimates were developed for each of these major source points on a tons/day basis. Mileage was calculated from the center of each of the municipal or township source points. Data were available from the U.S. Environmental Protection Agency on the costs/ton/mile for transporting waste in a 20 cu. yd. packer truck [29]. Updating the EPA data for increased fuel and oil prices resulted in an estimated transport cost of $.205/ton/mile. Figure 2 illustrates the alternative disposal and recovery sites evaluated.

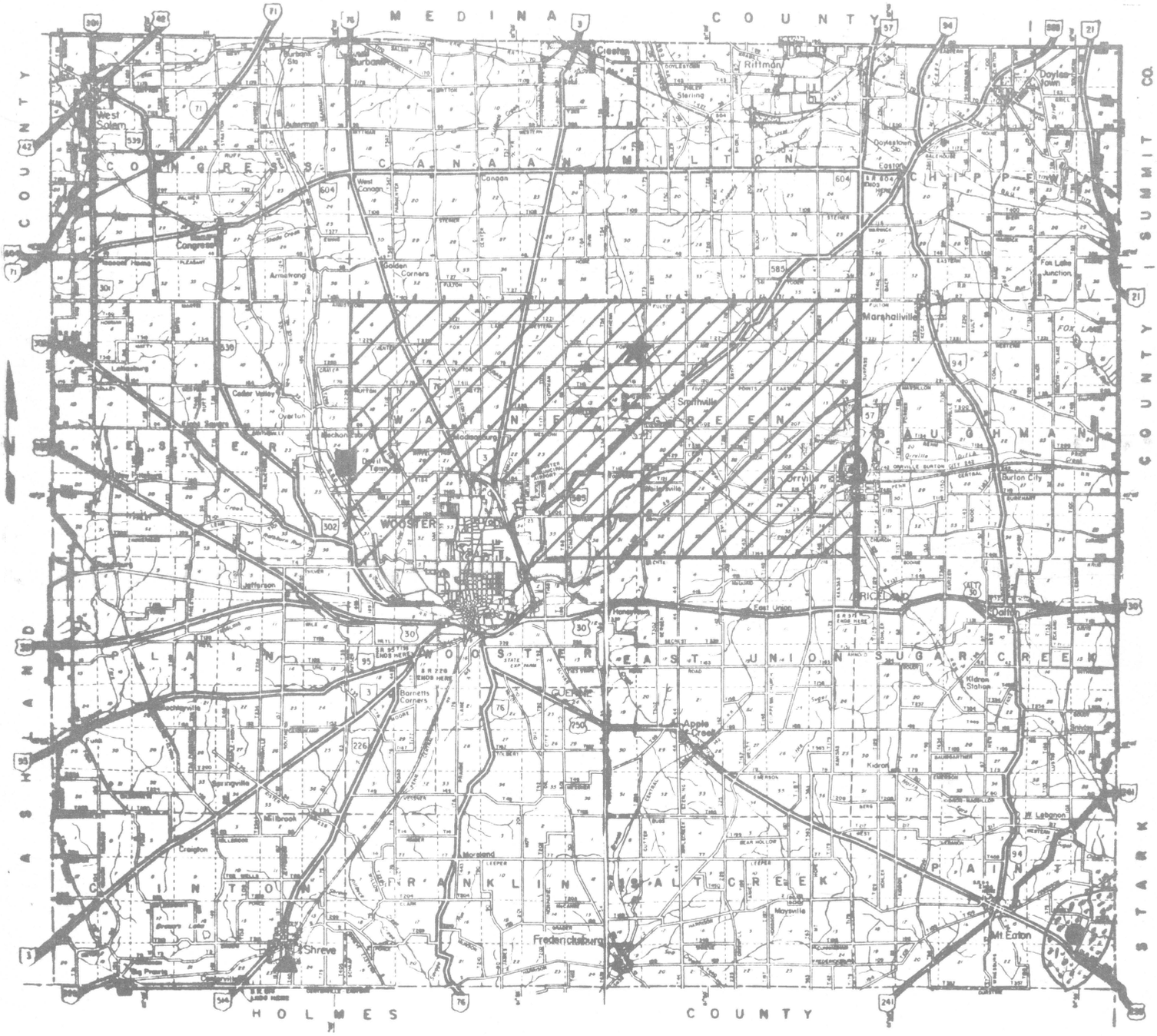
TABL

## Solid Waste Ton-Mile Transport Matrix

| Source Pts for Waste | Tons/Day | Nearest Bulk Box | Distance to Transfer, Disposal, or Recovery Point (miles) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | County Airport | Wooster Landfill | Mt. Eaton III & II | Mt. Eaton New Area | Tus. Co. Landfill | Green Tws. Landfill | Orrville Plant |
| **Cities** | | | | | | | | | |
| Wooster | 100.24 | - | 7 | 5 | 18.2 | 16.3 | 28 | 9.2 | 10.9 |
| Orrville | 70.49 | - | 8.4 | 13.4 | 16.6 | 15.8 | 26.4 | 3.7 | - |
| Rittman* | 42.79 | - | 11.7 | 17.2 | 24.1 | 23.3 | 33.9 | 10.1 | 9.3 |
| **Villages** | | | | | | | | | |
| Apple Creek* | 9.21 | | 11.4 | 15 | 10.5 | 9.7 | 20.3 | 8.7 | 12.6 |
| Burbank | 0.69 | | 14.9 | 12.6 | 32.5 | 31.7 | 42.3 | 18.8 | 22.7 |
| Congress* | 2.07 | | 16.7 | 14 | 34 | 33.2 | 43.8 | 17.3 | 21 |
| Creston | 3.17 | | 9.8 | 13.2 | 31.2 | 30.4 | 41 | 13.7 | 17.4 |
| Dalton* | 5.58 | | 16.2 | 19.7 | 10.1 | 9.3 | 19.9 | 13.3 | 6.8 |
| Doylestown* | 9.36 | | 14.9 | 19.8 | 23.5 | 22.7 | 33.3 | 11 | 10.1 |
| Fredericksburg | 1.17 | | 18 | 18.9 | 12.8 | 12 | 22.6 | 15.3 | 14.4 |
| Marshallville | 1.34 | | 10.7 | 15.6 | 17.4 | 16.6 | 27.2 | 6.9 | 5.1 |
| Mt. Eaton* | 1.87 | | 19.3 | 22.9 | 2.6 | 1.8 | 12.4 | 16.6 | 14.1 |
| Shreve* | 4.40 | | 17.8 | 14.1 | 21.9 | 21.1 | 31.7 | 20 | 21.7 |
| Smithville* | 5.22 | | 3.1 | 8 | 19.4 | 18.6 | 29.2 | 2.2 | 5.9 |
| West Salem | 2.10 | | 17.7 | 15 | 35 | 34.2 | 44.8 | 18.3 | 22 |
| **Townships without central village** | | | | | | | | | |
| Baughman | 2.01 | | 12.9 | 17.8 | 13.1 | 12.3 | 22.9 | 8 | 3.8 |
| Chester | 1.92 | | 15.8 | 9.6 | 25.9 | 25.1 | 35.7 | 16.8 | 20.5 |
| Franklin | 1.94 | | 14.2 | 12.3 | 18.1 | 17.3 | 27.9 | 16.4 | 18 |
| Plain | 1.76 | | 16.9 | 15 | 24.8 | 24 | 34.6 | 13.4 | 17.1 |
| Wayne | 3.15 | | 4.2 | 4.7 | 22.6 | 21.8 | 32.4 | 5.2 | 8.9 |
| Wooster | 4.07 | | 9.4 | 7.5 | 15.8 | 15 | 25.6 | 11.6 | 13.2 |
| Canaan | 1.51 | | 12.3 | 10.7 | 23.1 | 22.3 | 32.9 | 6 | 9.7 |
| Salt Creek | 1.30 | | 15 | 17.9 | 9.8 | 9 | 19.6 | 12.3 | 11.4 |

*Includes waste from surrounding township.

Figure 2. Disposal and Recovery Alternatives




▲ - Shreve Sanitary Landfill

● - Twilight Mining Landfill (Mt. Eaton)

■ - Wooster Disposal Landfill Incorporated

★ - Landfill or Transfer Station at County Airport

▨ - Alternative Landfill Site if no Airport Site

Expansion of Mt. Eaton Area

Orrville Energy Recovery System

Existing Disposal Sites

Estimates of the remaining life of Wooster Disposal Landfill varied greatly depending on who was doing the estimating. The most reliable estimate seems to be 2-3 years remaining life at the present rate of use and slightly upgraded management. It has been suggested that the operator should go to the trench method of landfilling. The change to this method would probably involve some increase in the user-charges for disposal at this sanitary landfill.

The Twilight Mining Landfill (Mt. Eaton Phase III) has up to one year of life remaining depending on the management. If present management practices are continued, less than one year of life remains. The upgrading of management would include better compaction of the waste and better coverage. With these changes, the landfill may last for one year at the current rate of use.

The Mt. Eaton Phase II site is located adjacent to the preceding site and is not yet operational. With management similar to that currently in operation at Phase III, the life expectancy of this site is about three years at the current usage rate. With greatly improved management as compared to that currently at Phase III, the life could be extended to six years. However, if the Wooster Disposal Landfill is closed in three years or less and the waste going into that site is routed to Mt. Eaton Phase II, the annual amount of waste going into the Mt. Eaton site would more than double after the first three years of its life. This would greatly reduce the remaining years of life of this site. The county engineer estimates

that it would cost approximately $170,000 to upgrade the roads in the vicinity of the Phase II site to handle the additional traffic.

The Shreve Landfill has an expected life of 10 years at its current rate of use. Although the amount of waste taken in at this site is small (about 50 cu. yds. per month), the disposal of the waste from Shreve Village and Clinton Township avoids the increased cost of transporting the waste across the county to either of the other landfills, Wooster Disposal or Mt. Eaton.

New Disposal Sites in County

In the selection of a new landfill site, consideration must be given to geology, topography, soils, cost, and acceptance by residents in the immediate area. Proper geological, topographical, and soils conditions help prevent surface or sub-surface water pollution and these conditions must be satisfied before looking at other factors. Costs include acquisition, preparation, and operation cost of the landfill site as well as transport costs to the site. Acceptance by local residents depends on whether they perceive a sanitary landfill as a desirable or undesirable neighbor. Given these factors, the following two areas of Wayne County appear to be worthy of further investigation as a future sanitary landfill site:

1. Wayne or Green Townships

   The survey of waste generation indicated that the center of waste generation is located in the general area of Wayne and Green Townships. The location of a landfill in this area would minimize transport costs since the majority of waste being produced

in the county is located relatively close to this area (see Table 4). General soil maps show that this area has soil conditions that could be used for landfilling. Further exploration could determine which areas could or could not be used for landfills. The county airport land might be explored as a potential site since the ownership is already held by the county. The resistance to a landfill from residents in this area would probably be high. A general education program, showing how a properly managed landfill can become an asset rather than a liability, might reduce this resistance.

2. Mt. Eaton Strip Mine Area

In the Mt. Eaton area there are many acres of old strip mined land that could possibly be used as landfill area. Part of this land is already being used for landfilling, but other areas have not been developed. Only by further exploration of physical traits of this area can the amount of available landfilling area be determined. Some of the areas may need modification to be used as landfill sites. The social pressure and land acquisition cost will probably be lower for this area compared to the Wayne and Green Township area. The transport cost and cost of upgrading adjacent roads in Mt. Eaton area would be much higher. A transfer station would probably be needed in the area of major waste generation to lower transport costs to the Mt. Eaton area.

Disposal in Surrounding Counties

Transporting waste out of the county has some misleading appeal. It solves the generating county's problem of disposal of waste and means that no landfills will need to be located in that county. However, this system involves two major problems, high transport costs, and securing long-term contracts with surrounding counties to accept the waste.

The cost of transporting waste into surrounding counties would probably be higher than operating a good landfill within the county. In Wayne County, a high percentage of the waste being produced is centrally located in the county. To transport this waste to an adjacent county for landfilling would appear to be relatively costly even if the landfills are located near the boundary of Wayne County.

Many counties are now experiencing the same problem as Wayne County, inadequate landfill capacity. Therefore, many counties have or are considering prohibitions on who may dispose of waste in county operated landfills. These laws usually prohibit disposal of waste from outside the county. In addition, long-term contracts with many private operators are not possible.

Preliminary Transport Cost Estimates on Disposal Alternatives

Detailed estimates of acquisition, preparation, operation, and transport costs for the various disposal alternatives are currently being developed as part of Richard Poling's M.S. thesis. However, it is possible to make some comparison of these alternatives utilizing transport cost

(from source to disposal points) data developed from Table 4 and the updated EPA ton-mile cost estimates. For each of the following major alternatives, the solid waste from each source point was allocated to its current or potential disposal point. Transport costs for each alternative were calculated by multiplying ton miles times the cost/ton/mile ($.205) for transporting waste in the modal type packer truck (20 cu. yd.) utilized in Wayne County. The results follow:

1. Under the current system in Wayne County, it is estimated that 239 tons/day are going to the Wooster Landfill and 39 tons/day to Mt. Eaton,,Phase III. Utilizing the above procedure, transport costs for the current system are estimated to be $203,848/year. This estimate does not include collection costs incurred prior to transporting a load of solid waste to a disposal point. The earlier discussion of overlap in the current system would suggest that collection costs may be unnecessarily high due to this factor.
2. If all (278 tons/day) of the current solid waste in Wayne County were transported to Mt. Eaton Phase III and II, transport costs are estimated at $336,180/year. This is a 39.4 percent increase in transport costs over the current system. This estimate does not include the cost ($170,000) of upgrading the roads adjacent to the Mt. Eaton Landfill area to handle the additional traffic. As in the previous

estimate for the current system, overlap of routes would continue to contribute to increased collection costs. Land acquisition costs would probably be considerably lower in the Mt. Eaton area but these costs are generally small when compared to transport costs. If all of the county's solid waste were transported to Tuscarawas County for disposal at Eddie Kohl's landfill, transport costs would increase 60-70 percent over the Mt. Eaton alternative utilizing the same mode of transport. As indicated earlier, it may be necessary to combine a transfer station with either the Mt. Eaton or Tuscarawas disposal alternatives.

3. A new landfill could be located at or near the County Airport to be used exclusively or in conjunction with a Mt. Eaton area landfill. Under this alternative, it is assumed that the solid waste from each source point would go to the closest of the two landfills. Given this assumption, transport costs are estimated at $161,959/year or a 20.5 percent decrease from current transport costs. However, only 19 tons/day of solid waste are allocated to the Mt. Eaton disposal area under this alternative. This is probably an inadequate volume to justify operation of this landfill in this area. Additional analysis may show the total operating costs of a Mt. Eaton area landfill to be sufficiently lower than the County Airport area to justify some increase in the volume of solid waste transported to the Mt. Eaton area for disposal.

Orrville Steam Generation

The city of Orrville is rather unique for a city of its size with its own municipal power plant. Preliminary estimates show that with modification of the present boilers, combustible solid waste could be burned in combination with the coal currently used to produce steam at the municipal power plant. Capital, costs of implementing such a system have been estimated between 2 and 3 million dollars with revenue coming from a dump charge of approximately $2.50 to $3.50 per ton, sale of ferrous metals recovered before burning, and savings from using less coal. Burning 20 percent solid waste and 80 percent coal, this system would be able to handle approximately 125 tons per day initially. The remainder of the county's solid waste and the ash from the boilers would go to landfill(s) in the county.

This alternative may take 5-7 years to develop to fruition and as such does not provide a solution to Wayne County's solid waste problem in the short run. However, preliminary investigation of this alternative is encouraging and it would appear to merit further study. Thus, it will be the focus of an M.S. thesis by Mark Luttner, a graduate student in resource economics.

## Evaluation of Storage and Collection Alternatives

"Mailbox" Pickup System

This system is an expansion of the current system to include all residents of the county in a door-to-door pickup system. Each rural residence would place their solid waste by their mailbox. Since rural

mailboxes are located on one side of the road, this facilitates collection by the packer trucks now in operation. Any urban customers added would comply with the established format of the private haulers on placement of waste for collection. The addition of these customers to the private haulers would require higher transport costs per customer and would likely require more equipment than the haulers presently have. Therefore, a charge of $.25/month/household was added to the collection cost of all customers in the county as an approximation of the added revenue needed to cover the fixed cost of any new equipment and the higher variable costs of servicing additional residences.

It was assumed that the total present customers equal the number in the current system, 22,032. Assuming 3.5 people/residence in the county, there are: 87,123 (population in 1970 U.S. Census) ÷ 3.5 = 24,892 potential customers in the county. Therefore, 88.5% of the residents in the county are now being served. The coefficient for including the remaining residents in a pickup system is 1.13.

Assuming the $.25 per month increase to all customers, the total cost of the current plus mailbox system would be:

Collector A: $3.00/mo. x 4844 customers x 1.13 = $16,421

Collector B:
a) $2.50/mo. x 5000 customers x 1.13 = $14,125
b) $2.00/mo. x 2300 customers x 1.13 = $ 5,198
c) $3.00/mo. x 350 customers x 1.13 = $ 1,187
d) $3.50/mo. x 4850 customers x 1.13 = $19,182

Collector C: $4.75/mo. x 4688 customers x 1.13 = $25,163
(includes Baughman Township)

Total Residential Cost = $81,276/mo.

Net increase in cost over the current system = $81,276
-$62,446
$18,830/month or $225,960/yea

Total cost of current plus "mailbox" system = $2,098,632/year

"Green Box" System

This system could be used to collect waste primarily from rural residents not currently being serviced by private haulers. The small bulk boxes would be placed at different locations in the county where service by private haulers is not economically feasible and/or available. The exact locations of the boxes would need to be determined at the time of implementation, however, the sites should have the following characteristics:

a) Close to but not necessarily on a main highway.

b) Accessible to the residents being served by it but probably not more than one site per rural township.

c) Located off the road far enough that parked cars will not block traffic.

d) Be on an all weather site, that is, the site should be usable in winter or other inclement weather.

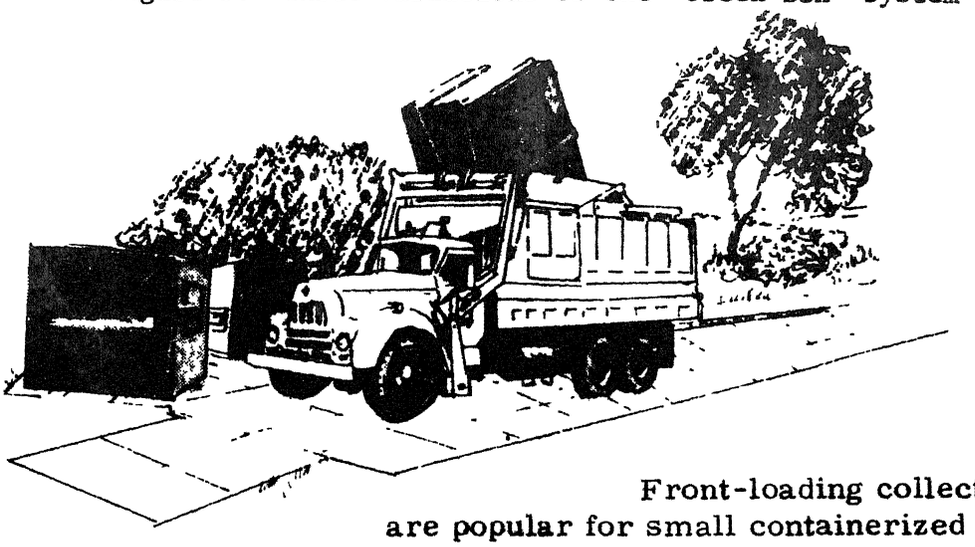
e) Have enough room for the collection truck to maneuver for pickup.

f) Be near some residential grouping, if possible, to deter vandalism and illegal dumping.

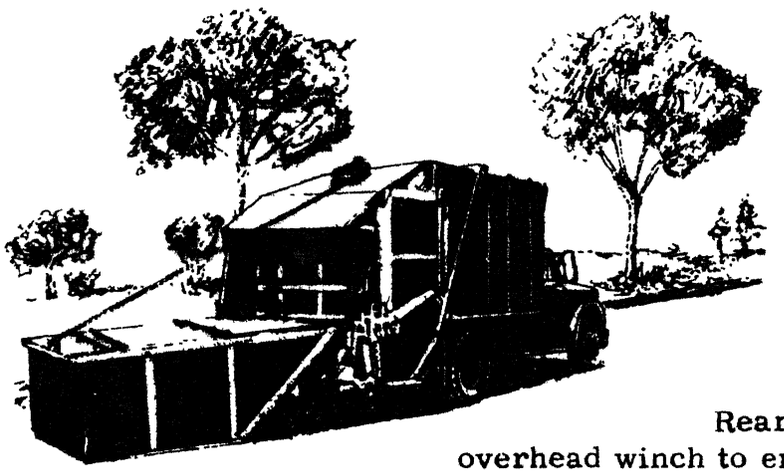
For the following calculations, six cubic yard boxes were used because the present fleets of the private haulers would all be able to accommodate this size box. Cost of servicing the boxes is the price currently charged by one of the private haulers. Figure 3 illustrates this system using front, rear, and side-loading collection trucks.

From the previous calculations, there are approximately 2,860 customers in the county not being serviced presently by private haulers. It is assumed that these are in the unincorporated areas of the county.

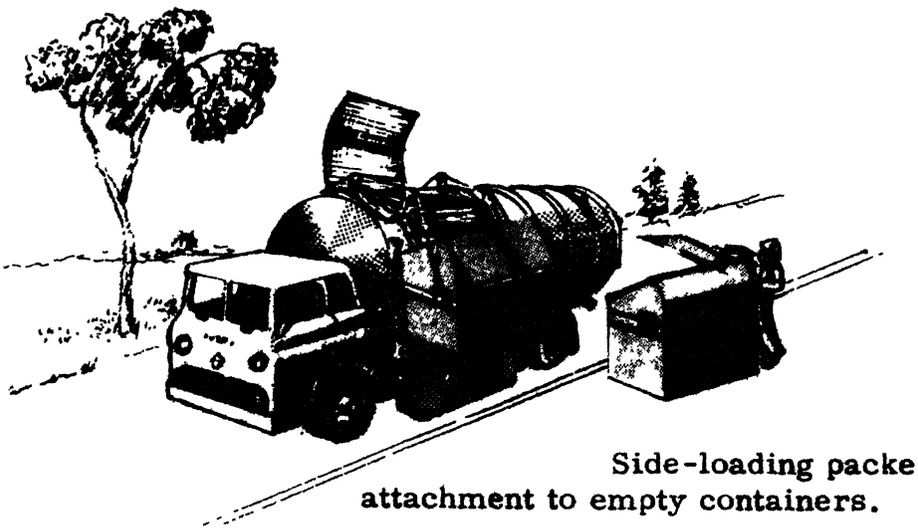
Figure 3. Three Variations of the "Green Box" System



Front-loading collection vehicles are popular for small containerized systems.



Rear-loading packers use an overhead winch to empty containers.



Side-loading packers use a special attachment to empty containers.

**Source: [11]**

Using .20 cu. yd./residence/week [11], there are 572 cu. yd./week of waste not being collected. From the previous pilot project in the county, it was determined that 81% of the potential users actually used the boxes [15]. Thus, 463 cu. yd./week would go into the boxes. Assuming two pick-ups per week, there would be 232 cu. yd./pick up. Using six cubid yard boxes and assuming they will be loaded to only 66% of their actual capacity through improper loading or bulky items, 58 boxes will be needed for the county given the current sanitary land-fill locations.

The following cost analyses will cover two options open to the county. The first involves the county purchasing the boxes and paying the private hauler a service charge. The second option includes the rental a boxes from the private hauler and paying a service charge for their collection:

1. If boxes are owned by county:

   Capital Cost

   58-six cu. yd. boxes @$463 = $26,854

   Operating Costs

   Service for each box at two pick-ups/week = $60/mo.

| | |
|---|---|
| 58 x $60.00/mo. = | $ 3,480/mo. |
| | 12 mo./yr. |
| | $41,760/yr. |
| Depreciation on boxes over 11 years (Straight Line) | + 2,441/yr. |
| Total | $44,201/yr. |

2. If boxes are rented from private hauler:

Operating Costs

| | |
|---|---|
| Rental of box per month = cost of box/24 months | = $463.00/24 |
| | = 19.29/mo./box |
| Service for each box at two pick-ups/week | = 60.00/mo./box |
| Total cost/box/month | = $ 79.29 |
| 58 boxes @$79.29/box/month | = $4,599/month |
| | x 12 mo./yr. |
| "Green Box" System Total | = $55,188/year |
| Current System & "Green Box" Total | = $1,972,860/year |

The capital cost for the first option does not include the preparation of sites for the green boxes. This amount would depend upon the number and elaborateness of sites. By using county owned equipment, personnel and materials, these costs could be kept at a minimum. Basic site preparation was estimated at $100/site in an earlier pilot project [15]. Maintenance costs of the boxes were also not added as information on probable maintenance costs were unavailable. If the county owns the boxes, the use again of existing county equipment for this maintenance may reduce costs. If the boxes are rented from the private hauler, the hauler should be required to perform normal maintenance duties as specified in the contract.

Large Bulk Box System

This system is a variation of the "green box" or small bulk box system with 40 cubic yard roll-off bulk boxes being substituted for the six cubic yard boxes. The 40 cubic yard boxes allow for easier loading of bulky items and are capable of handling white goods (e.g. refrigerators, stoves, etc.). The larger boxes require a special truck chassis for transporting them from collection points to disposal sites and for unloading

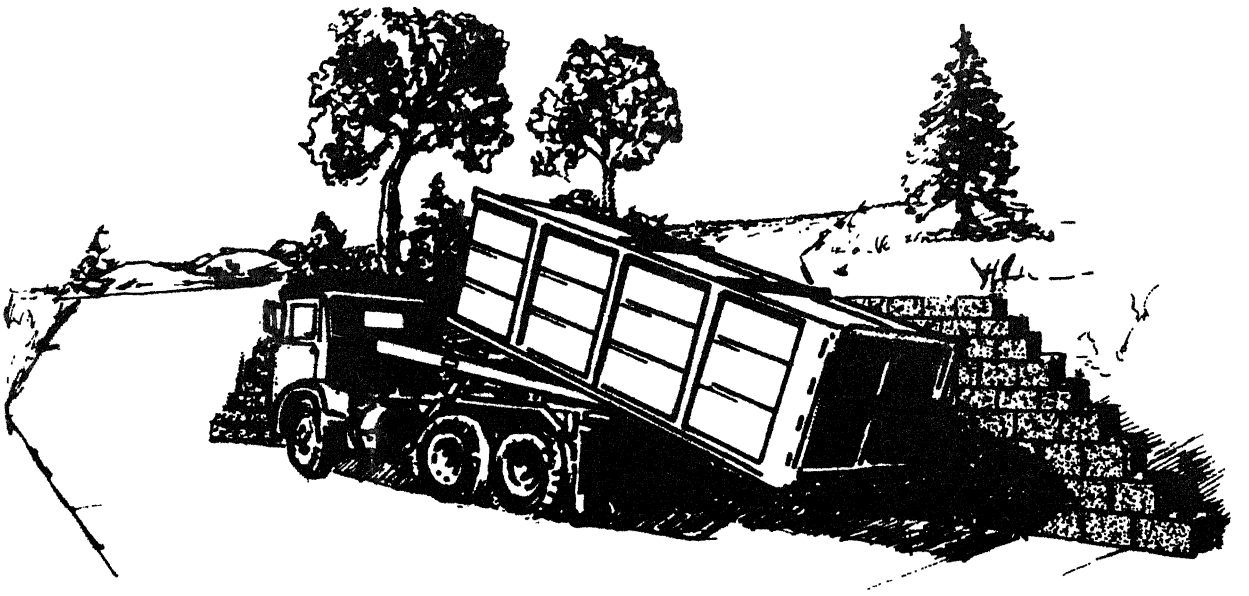
and loading them onto the chassis of the truck. Figure 4 shows how these boxes are loaded and unloaded.

The site preparation would be similar to the "green box" system, except that the site must be large enough to allow the truck to maneuver into position for loading and unloading.

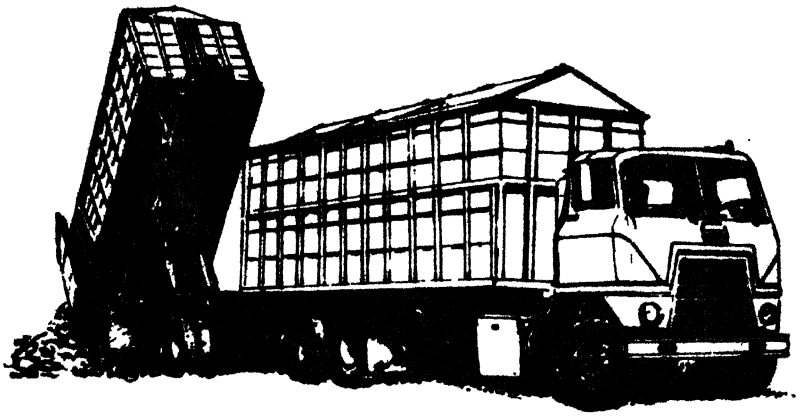
This system could be operated in two ways. The first way would be to substitute a 40 cu. yd. roll-off box for the "green" boxes in the previous system. By using the calculations from the "green" box system, at least 18 roll-off boxes would be needed. An additional box would be purchased to be used as a swing box, that is, when the boxes are picked up for disposal, an empty box would be left in place of the one being emptied. The driver would then empty the boxes during the week in a rotating manner so that each box is emptied at least once a week or more if needed.

The main disadvantage of this system in comparison to the "green box" system is that the waste is not compacted and thus transport costs/ton are higher. It may be possible to get some compaction by utilizing a back hoe, but evidence on this option is not conclusive. The sites should have minimal supervision to prevent vandalism and illegal dumping. In addition, the use of these large boxes may not be warranted in some areas where not enough waste is generated to fill one bulk box, at least on a weekly basis, or in areas where the amount of waste generated is somewhere between the capacity of the number of boxes that could be used. The problem is that the large bulk boxes are not as divisible as the smaller "green" boxes and it is more difficult to match the amount generated at the sites with the capacity of the containers.

Figure 4. Loading and Unloading Procedure
For Large Bulk Box System



Unloading containers requires adequate maneuvering space



Pull-trailer attached to a truck allows a combined load of 61.2m$^3$ (80 yd$^3$).

Source: [11]

The second way to operate the system is to rotate the boxes between the different townships during the week. The driver would go to a different site each day of the week and leave the box or boxes at the site for the entire day. Each township or site would be assigned one day out of the week for taking refuse to their bulk box site. The driver would probably stay at the site and supervise the dumping. If two boxes are used at the site, a box that is filled before the day is over could be taken to the disposal site and the other box left at the site for use by the residents. Over time, it would become apparent how many boxes could be filled during one day at the different sites. If the number of sites could not all be serviced in one week's time by this method, the driver might assign two nearby sites to the same day. This would involve placing boxes at both sites and having some communication between the sites for the driver to know when a box is filled and ready for disposal. Again, over time he would be able to anticipate the amount of waste from each site.

The equipment for this system includes a semi-tractor chassis with special roll-off equipment able to handle 40 cubic yard roll-off bulk boxes. The exact number of boxes needed will depend on the number of sites and the type of operation used. The following cost information is an approximation of the capital costs of this equipment. These may be high or low depending on the options ordered and the manufacturer. Detailed operating costs were not available for this system.

Capital Costs

Tractor with tandem roll-off chassis @ $40,000
40 cubic yard roll-off boxes @ $2,850

Portable Compaction Unit

This system is essentially the same as the 40 cubic yard roll-off bulk box system with a few added features, The boxes in this system are equipped with a hydraulic compaction system which allows each container to handle a greater volume of waste than the previous bulk boxes. Assuming a 4:1 compaction ratio, one container would be able to handle about 12 tons of waste. One compaction unit would be able to handle the potential volume of waste in any of the townships in Wayne County on a weekly or twice a week pick-up schedule (see Table 4). In some areas, the amount of waste generated may be too small to make this unit economically feasible.

If each township has an assigned day of the week for placement of a compaction unit in that township, two units would be needed to service the entire county. Another option would be to determine the high and low waste generation sites and use a combination of a compaction unit for the high volume sites and the uncompacted roll-off boxes for the low volume sites. Both types of boxes use the same type of truck roll-off chassis, so no new equipment would be necessary for combining the box types.

The site preparation for this system is the same as for the previous roll-off box system, except that the compaction unit requires an electrical outlet to operate the hydraulic power supply unit. This unit would also require a person to be at the unit site at all times to prevent accidents and/or damage to the unit through improper use.

The on-site cost of this system is higher than the uncompacted roll-off box system due to the higher capital and operating costs of the compaction box and the hydraulic system. A reduction in the transport cost/ton would occur due to the higher volume and weight that can be loaded into the same size box as the uncompacted system. This may offset the higher capital cost depending on the average loads and distances that the unit must travel for disposal. Detailed operating costs on this system were not available.

Capital Cost

| | |
|---|---|
| Semi-tractor with roll-off chassis | @ $40,000 |
| 40 cu. yd. compaction container with portable hydraulic power pack | @ $ 8,500 |
| | $48,500 |

Transfer Station Options

Transfer stations are by definition central collection and temporary storage facilities for solid waste. By this definition each of the bulk box systems discussed earlier is a form of transfer station. However, for discussion here the term transfer station will mean a facility that has compaction capability and is able to handle commercial collection vehicles as well as individual residents. The purpose of a transfer station is to reduce transport costs by compacting and loading the solid waste into transfer vehicles much larger than conventional collection trucks.

Up to a certain distance, conventional collection or packer trucks can be operated at less cost than a transfer vehicle. For a transfer

station to be considered, the cost of taking waste by collection truck and transfer vehicle must be compared. Appendix C compares the costs of operating a collection truck in Wayne County to the estimated cost of a transfer vehicle. The collection truck operates at $0.119/ton/minute of travel time. The transfer vehicle operates at $0.022/ton/minute of travel time. Due to the cost of owning and operating the transfer station and cost of time during loading and unloading, the transfer station does not become more feasible than the collection truck until a round trip of about 33 minutes is necessary (Figure C1).

Assuming that a 40 mile round trip could be covered in 60 minutes [29], the breakoff point between collection vehicles and a transfer vehicle is a round trip of 22 miles. Figure C2 shows the breakoff points in the county if the Mt. Eaton Landfill is the only landfill operating in the county. As long as the Wooster Disposal Landfill and the Mt. Eaton Landfill are both in operation, there would be no need for a transfer station. When the Wooster Disposal Landfill ceases operation and if another landfill site is not found in the northern half of the county, a transfer station appears to be an economically feasible means to transport the waste to the Mt. Eaton area.

The placement of a transfer station in the county would mean that some basic requirements be met. The most important requirement is that the station be located in the vicinity of the large waste producing areas. The area that would be most suited for this requirement is in Wayne and Green Townships. This area would result in lower transport costs for the waste being produced in the nearby cities of Wooster, Orrville, and

and Rittman, which amounts to over half the solid waste being produced in the county.

Another important item in transfer stations is the physical characteristics of the site. A minimum of about 1.5 acres is required for a basic transfer station. The grade of the site is very important. Transfer stations are two level operations, with the waste being discharged from the upper level into a transfer vehicle on the lower level. Some estimates indicate that the cost of excavation and earthmoving may be up to 25 percent of total capital costs. Adequate slope in a site can mean greatly reduced capital costs of a transfer station.

The type of transfer station that can be constructed is almost unlimited. The many options that can be added depend on the desired type of service and the amount of capital available for the transfer station. Many of the options can be foregone during the initial construction and added on at a later date if needed. The planning of a transfer station can be made with the idea of future expansion or addition of other equipment. With good planning, it is possible to update a transfer station to meet future needs including resource recovery.

The types of transfer stations that would appear to be most practical for Wayne County have different degrees of sophistication and require different types of equipment.

1. Compaction Apron and Pit Station

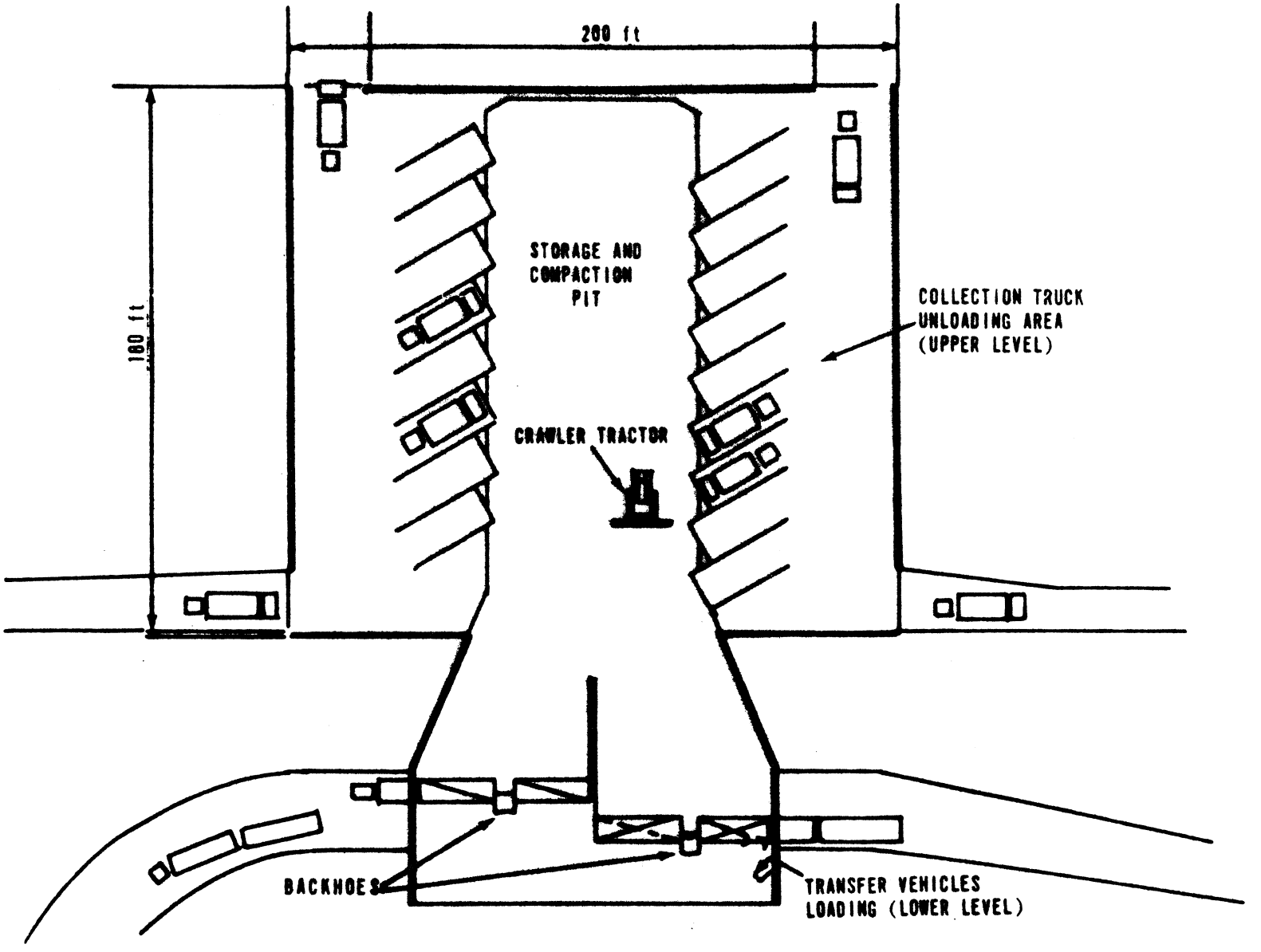
In this system, the waste is deposited on a concrete apron on the upper level of the situation. A crawler tractor then drives over the waste several times and pushes the waste over the apron lip into an open top

transfer trailer. The waste may then be load leveled by a back hoe or merely loaded until full by the crawler tractor. The full trailer is then replaced with an empty trailer and taken to the disposal or recovery site and unloaded. This system allows many vehicles to unload simultaneously which reduces long lines and waits for the collection vehicles. Figure 5 shows a facility of this type. The exact size of the facility would be determined by the volume of waste going to the transfer station and anticipated future needs.

The advantages of the compaction pit system are as follows: (1) a convenient and efficient storage area is available that does not clutter the unloading area; (2) uncompacted material is crushed in the pit making maximum payloads obtainable without further processing; (3) the open-top transfer trailers are lighter and capable of carrying larger payloads than the enclosed compactor trailers with their heavy reinforced steel bodies and hydraulic equipment; (4) the open-top trailers are usually less expensive initially and require less maintenance than the enclosed compactor trailers; (5) large volumes of waste can be handled very quickly and many incoming vehicles can be unloaded simultaneously; (6) drive through loading provisions for transfer vehicles can easily be incorporated into the design.

The compaction pit system has the following disadvantages: (1) considerable capital investment is required to construct the compaction pit and to purchase the crawler tractor; (2) unloading of open-top trucks is more difficult and usually takes more time than required with enclosed

Figure 5. Sample Diagram of Compaction Apron and Pit Transfer Station




As indicated in this floor plan of the compaction pit transfer station in San Francisco, simultaneous loading of two transfer vehicles and unloading of 17 collection trucks can be performed.

Source: [29]

compactor transfer trailers, and investment in disposal site unloading equipment may be required; (3) time is wasted in placement and removal of canvas or metal tops that are required to prevent littering during transport [29].

2. Internal Compactor Trailer System

This system is very simple in design. The waste is discharged on the upper level into a hopper which directs the waste into a transfer trailer with compaction capacity on the lower level. Each load is then internally compacted in the trailer. When the trailer is filled, it is replaced with another and driven to the disposal or recovery site for unloading. The size of the unloading hopper can be selected to provide storage if the amount of waste discharged is greater than the amount that can go into the trailer on each compaction cycle. This system is best suited for low volume operations due to its inadequate storage capacity during peak volume hours. Only one vehicle can unload at a time for each trailer. More trailers can be added to the site to ease the storage situation.

The advantages of the internal compaction trailer system are as follows: (1) the system is easily adaptable to small operations where incoming waste requires considerable compaction to achieve maximum payloads because only a ramp and hopper are needed to transfer the load to the trailer; (2) unloading of the trailers is very fast and efficient; (3) the enclosed nature of the trailer does not require that canvas or metal tops be handled with each loading and unloading; (4) maximum payloads

are easily and quickly obtained whether the incoming waste is in a compacted or uncompacted state.

The disadvantages of this system are: (1) should the hydraulic bulkhead compaction system within the trailer fail, the trailer is out of commission since there is no way of placing waste in the trailer; (2) the extra dead weight of the hydraulic bulkhead system and required steel reinforcement effectively reduce maximum payloads; (3) the initial cost of compaction trailers is higher than that of open-top trailers and they usually require more maintenance; (4) if the majority of incoming waste is precompacted in collection trucks, the heavier enclosed trailer offers little advantage as maximum payloads can easily be achieved in lighter open-top trucks with top tamping [29].

3. Stationary Compaction Facility

This system is the predominant system in use today. A transfer trailer is backed into position and locked to a stationary compactor that is firmly anchored in a concrete foundation on the lower level of the transfer station. The hydraulically powered recipricating arm of the compactor forces the waste horizontally through a door in the rear of the trailer. The waste is fed to the compactor chamber either by gravity flow through a hopper directly above the compactor or, if greater storage area is needed, the waste is discharged into a hydraulic push pit that can feed the waste into the compactor as need be.

If many trucks enter the station at the same time, the push pit allows a number of trucks to unload simultaneously and prevents build-up of truck traffic that may result with the hopper system. The push pit does not have

to be built into the original transfer station design. By constructing the initial foundation to accommodate the push pit without major modification, the push pit can be added at a later time when the volume of waste at the station requires greater storage.

The stationary compactor transfer system requires that the trailers be backed into position to be attached to the compactors. Incoming vehicles must also back into position to unload into the compactor hopper or into the storage area. Therefore, ample turnaround space must be provided for both areas.

The advantages of this system are: (1) maximum payloads can easily be obtained with uncompacted or compacted solid waste; (2) unloading of the trailers is very fast and efficient; (3) the enclosed nature of the trailer does not require that canvas or metal tops be handled with each loading and unloading; (4) the compactor can handle nearly all bulky material that can be placed in the hopper because of the large hydraulic force available; (5) the incoming waste usually receives minimum exposure because it is rapidly pushed into the sealed trailers.

The disadvantages are: (1) should the compactor fail, there is no way of loading the trailer; (2) the extra dead weight of the ejection bulkhead system and required steel reinforcement in the transfer trailer effectively reduce maximum payloads; (3) the initial cost of the trailers is higher than open-top types and they usually require more maintenance; (4) a drive-through system for transfer trailer loading is not possible with current compaction systems; (5) if the majority of incoming waste is

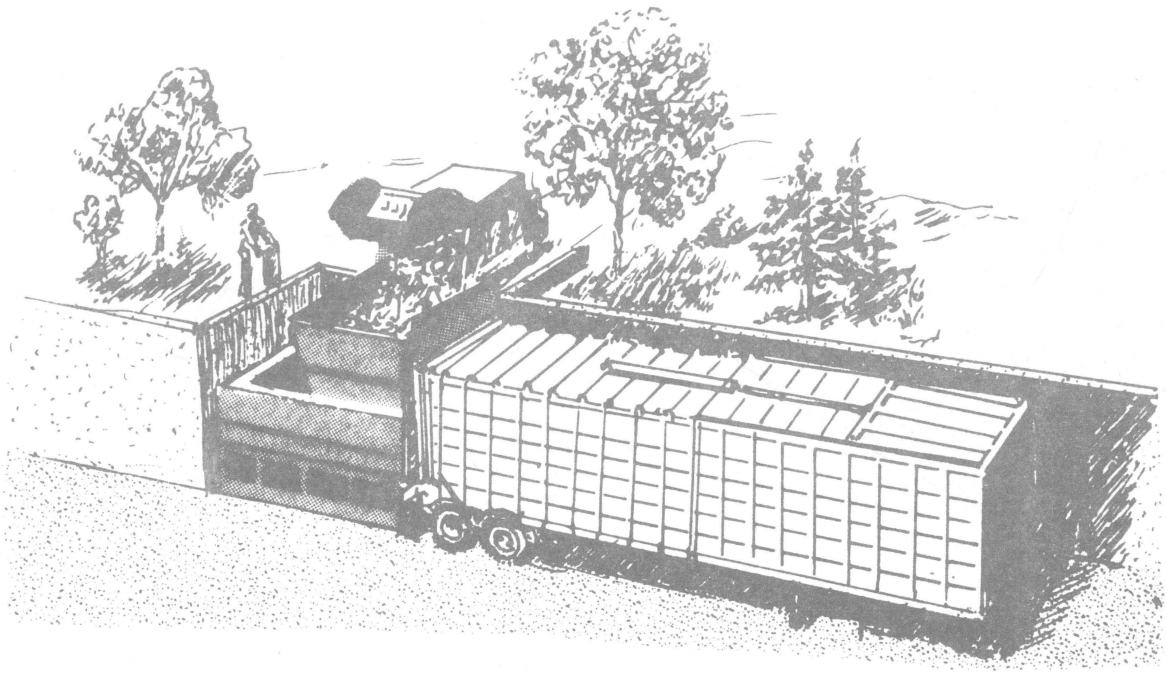
precompacted in collection trucks, the heavier enclosed trailer offers little advantage as maximum payloads can be achieved in lighter open-top trailers with top tamping [29]. Figure 6 shows two types of stationary compactor systems, the top figure is a simple open air system and the bottom figure is a sophisticated enclosed station with a push pit for added storage.

Estimating the cost of a transfer station is very difficult since the final cost will depend on the system used, the equipment package selected and the site qualities with regard to excavation costs. The cost estimating requirements listed in Appendix D are a good blueprint for determining total cost once the system is selected and the site chosen.

A transfer station with the stationary compaction system was built in Hamilton, Ohio in 1970. This station is an enclosed system with push pit that handles approximately 200-250 tons per day and serves a population of around 80,000 people. The current cost of a station similar to this one would be around $350,000 based on estimates from the equipment distributer for the Hamilton facility. The total operating costs for that station in 1973 were $2.72/ton for transfer and $3.02/ton for dumping, compacting, and loading.

The following are estimated capital costs for the major items of equipment usually found in transfer systems and an estimate of their expected life. These capital or fixed cost figures are from equipment dealers and may vary from one dealer to another or may vary in different areas of the country. They are not exact values but are good estimates for the general type of equipment described.

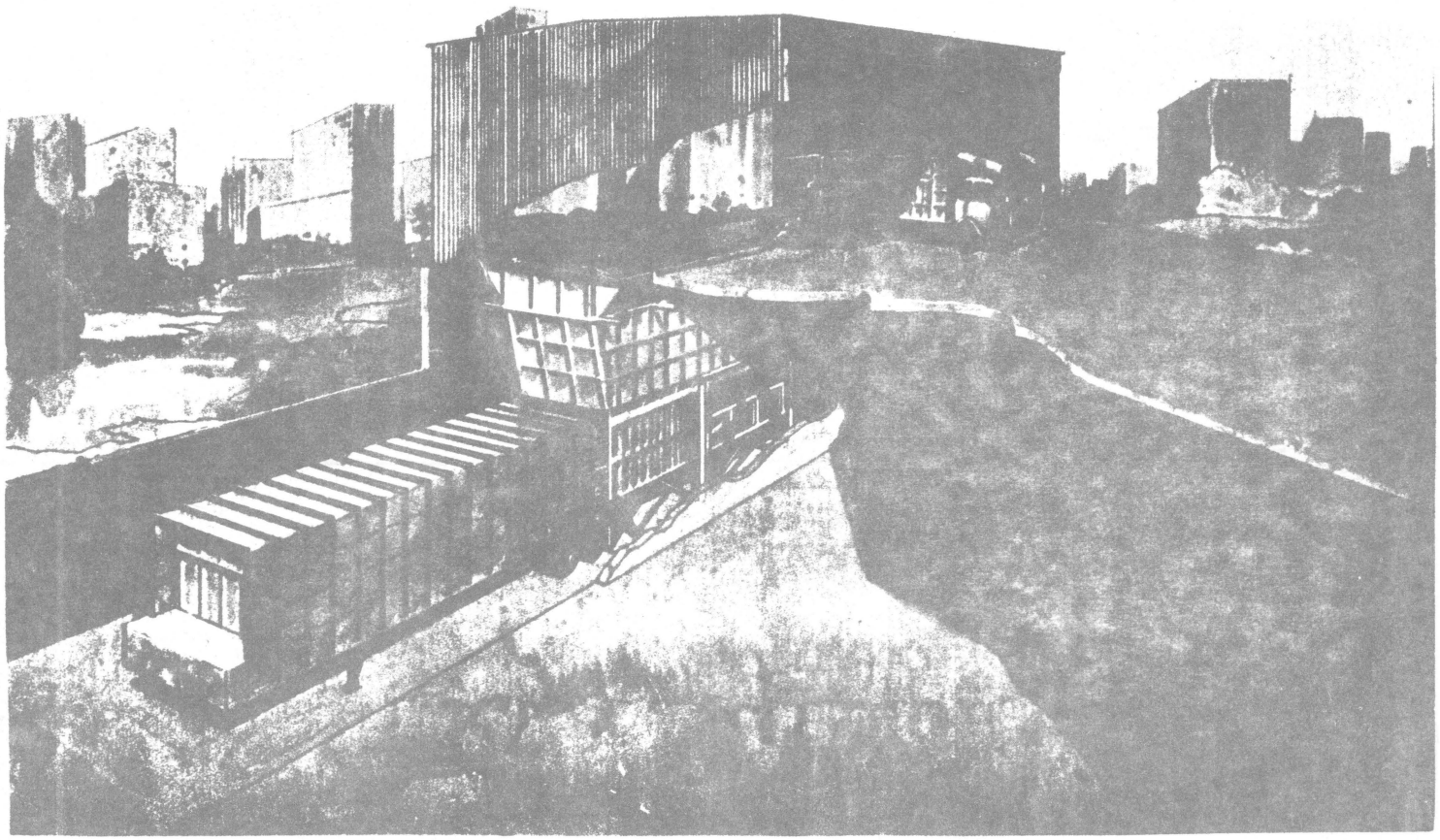
Figures 6a & 6b. Two Types of Transfer Stations Using Stationary Compactors



a. Collection truck discharges waste into stationary packer for loading into transfer trailer.

Source: [11]

b. Enclosed Transfer Station With Push Pit For Added Storage



Source: [E-Z Pack Company, Galion, Ohio]

| | | |
|---|---|---|
| Stationary Compactor | $20,000 | 10 years |
| Push Pit | $35-$40,000 | 10 years |
| Tractors | $28,000@ | 5 years |
| Trailers | $26-$34,000@ | 7 years |
| Scales | $28-$30,000 installed (60 ton capacity) | |
| Auxiliary Power Unit | $5-$5,500 | |

Building:

| | |
|---|---|
| Excavation and earthmoving | $25,000 min. |
| Concrete - 20' x 60' apron | $16,000 min. |
| Steel Building | $12,000 min. |

## Summary of Tentative Recommendations

As was indicated at the outset of this report, additional analysis of the Wayne County solid waste situation and some extensions of the analysis to other situations is progressing as part of two M.S. theses in resource economics. More detailed recommendations may be possible at the completion of these two graduate student research efforts. This is particularly true of questions on the optimal organizational forms (e.g. public, private, mixed) and fiscal mechanisms (e.g. tax, loan, user charge, bond) as well as more precise estimates of the benefits and costs of resource recovery. Short of this additional evidence, some tentative recommendations follow:

1. The county, city, and village officials in Wayne County need to proceed toward establishment of a comprehensive county-wide Garbage and Refuse District under Section 343 of the Ohio Revised Code. This legal entity provides for issuance of bonds to finance capital costs which can be retired by revenue received from the improvements. It

also provides for ad valorem taxing power to deal with the operational expenses of any solid waste system that may be developed in this county. Such a District currently exists but does not include the incorporated places in Wayne County.

2. Local officials need to be investigating alternative sites for a publically owned sanitary landfill. Locating this landfill at the County Airport or in the area of Wayne and Green Townships would minimize transport costs and probably result in the least cost system for disposing of Wayne County's solid waste. There may be opposition to a sanitary landfill from the residents of Wayne and Green Townships. Securing land for a publically operated sanitary landfill in the Mt. Eaton area would probably result in less opposition from local residents, but would increase system costs even in combination with a transfer station. Operation of the publically owned sanitary landfill could be either public or private depending on the interest shown by private contractors. Wooster Landfill will probably need to be phased out in 2-3 years.

3. Local officials should consider implementing additional pilot project(s) on rural storage and collection systems in addition to the two systems that have been piloted to date. Possible systems include a 40 cu. yd. bulk box system and a 40 cu. yd. portable compaction unit. Based on the analysis of alternative disposal and recovery systems and current routing patterns in Wayne County, it would appear that Baughman, Milton, Plain, Franklin, and Congress Townships might be the logical prospects for any additional pilot projects. A given bulk box site could serve one or more townships.

4. Resource recovery via burning combustible solid waste at the Orrville municipal power plant appears to be 5-7 years away. Even if this alternative becomes a reality, it would probably handle less than half the total solid waste generated in the county. It would also produce an ash residual which would need to be disposed of in a sanitary landfill. Nevertheless, this alternative will be the subject of further analysis and would appear to merit serious consideration by local officials.

5. If a decision is made to locate a publically owned sanitary landfill in the Wayne and Green Townships area, no major transfer station would be required unless resource recovery at Orrville becomes a reality. In this case, it would probably be necessary to develop a solid waste receiving and processing facility adjacent to the Orrville power plant. If a public sanitary landfill is located in the Mt. Eaton area, a transfer station could be located adjacent to the Orrville power plant. This transfer station could be readily adapted for resource recovery processing if and when steam generation from solid waste becomes a reality. Alternatively, the transfer station could be located at the County Airport. This alternative would involve increased transport and processing costs if resource recovery becomes viable at Orrville.

6. Once the decisions on a new landfill and/or transfer station site(s) and resource recovery have been made, it will be possible to make more detailed recommendations on organizational and financial options. Based on these decisions, the foregoing analysis, and the pilot project evidence, it will also be possible to recommend a supplementary storage and collection system for the unincorporated areas of the county.

7. None of these recommendations are viewed as counter productive to any multi-county initiatives that may be explored or realized at some future time. With the possible exception of resource recovery, Wayne County has a large enough population base to realize most of the size economies inherent in the various solid waste system components. This is particularly true in a time of rising fuel prices with their disproportionate effect on transport costs. If resource recovery becomes a reality on a multi-county basis, the solid waste generated in each county must still be collected, compacted, transported, and processed before it can be recovered. A regional solid waste legal entity (e.g. Council of Governments or Sanitary District) would also need to replace the County Garbage and Refuse District.

Appendix A Solid Waste Definitions

1. Composting - means the controlled biological decomposition of solid organic waste material under aerobic conditions.

2. Facility - means any device, mechanism, equipment, or building used for stabilization, conversion, permanent storage, transfer, or incineration of solid waste, whether or not generated on the premises where the facility is located, or for resource recovery.

3. Ground Water - means any water below the surface of the earth in a zone of saturation.

4. Hazardous Material - means material that is toxic, poisonous, irritating, sensitizing, radioactive, explosive, or biologically infectious, or that may have either acute or chronic effects on the health of individuals coming into contact with such material.

5. Health District - means a city or general health district as created by or under authority of Chapter 3709. of the Ohio Revised Code.

6. Incinerator - means any equipment, machine, device, article, contrivance, structure, or part of a structure used to burn solid waste.

7. Leachate - means the substance that results when liquid percolates through solid waste.

8. Open Dumping - means the depositing of solid wastes into a body or stream of water, or onto the surface of the ground at any location other than a solid waste disposal site or facility licensed under Ohio Revised Code Chapter 3734 and these Chapters, EP-20 and EP-33.

9. Resource Recovery - means the extraction of usable materials and/or energy from solid wastes through processes of extraction, conversion, or separation.

10. Sanitary Landfill - means a method of disposing of solid waste on land without creating nuisance or hazards to public health or safety, and without causing or contributing to air and water pollution, by utilizing the principles of engineering to confine the solid waste to the smallest practical area, to reduce it to the smallest practical volume, and to cover it with a layer of earth at the conclusion of each day's operation, or at such more frequent intervals as may be necessary.

11. Site - means any location, place, or tract of land used for stabilization, permanent storage, conversion, transfer, or burial of solid wastes, whether or not generated on the premises where the site is located, or for resource recovery.

12. Solid Wastes - means such unwanted residual solid or semisolid material as results from industrial, commercial, agricultural, and community operations, excluding earth or material from construction, mining, or demolition operations and slag and other substances which are not harmful or inimical to public health, and includes, but is not limited to, garbage, combustible and non-combustible material, street dirt, and debris.

13. Solid Waste Disposal - means the final disposition of solid wastes.

**Appendix B. Wooster Landfill Violations**

State of Ohio Environmental Protection Agency, Box 1049, 450 East Town Street, Columbus, Ohio 43216 (614) 469-3543

Northeast District Office
Waste Management & Engineering
2110 East Aurora Road
Twinsburg, Ohio 44087

January 11, 1974

Re: Wayne County
Solid Waste

Mr. John H. Thomasetti
Wooster Disposal, Inc.
531 East Liberty Street
Wooster, Ohio 44691



Dear Mr. Thomasetti:

This writer received your letter of November 14, 1973, and wanted to look at your landfill once again before replying to you. An inspection was made on January 8, 1973.

You are operating a licensed sanitary landfill in the State of Ohio and hold a state license which is issued by the Wayne County Health Department acting as an agent for the Ohio EPA. Due to the limited staff of the EPA it is necessary for us to depend on the local health departments to inspect and license the sanitary landfills. Therefore, you as a landfill operator are responsible to the Wayne County Health Department and the Ohio EPA to operate a proper sanitary landfill according to the laws of the state. However, since you do have a contract with the City of Wooster, they probably have a right to be concerned as to the status of your landfill operation, but they do not have any power as to enforcing the Solid Waste Laws.

In answer to your comment concerning cooperation with the Wayne County Health Department and the Ohio EPA, it has not been demonstrated that you have implemented any of the suggestions this department made. During the January 8 inspection there were several violations noted and most were the same ones noted on June 21, 1973, by this writer.

The following is a list of those violations:

1. Salvaging was being conducted on the site.

2. There was not sufficient compaction being done; this may increase the leachate flow this summer.

3. The solid waste had not been covered for at least two weeks.

4. What was covered was not sufficiently covered.

5. The cover was being dug several hundred feet away from the working face, making it almost impossible to finish covering at a decent hour.

When the above violations have been corrected please inform Mr. Robert Strock of the Wayne County Health Department and at that time this office will re-inspect and write a report to the city concerning the operation of the landfill.

Sincerely,

Michael T. Heher
District Sanitarian

cc: Engineering Associates LMTD, 700 Winkler Drive, Wooster, Ohio, 44691, Attn: Charles Mann
Central Office - Attn: Don Day
Northeast District Office - Attn: John Januska
Northeast District Office - Attn: Jeff Lintern
Wayne County Health Department.

MTH:jrn

## Appendix C. Collection Truck vs. Transfer Vehicle Costs

### Collection Truck Costs

| Annual Time Costs: | Cost |
|---|---|
| Depreciation on truck, less tires, over 6 years | $ 5,840 |
| Driver's salary | 17,395 |
| Collectors salaries 2 @11,515 | 23,030 |
| Fringe Benefits @ 25% of salaries | 10,107 |
| Interest on truck investment less tires @ 6% | 1,752 |
| Taxes and licenses | 1,000 |
| Insurance | 750 |
| Total Annual Time Cost | $59,874 |

Cost/min. @ 260 working days and 8 hrs./day

$$\frac{59,874}{260 \text{ days} \times 8 \text{ hrs.} \times 60 \text{ min.}} = \frac{59,874}{124,800 \text{ min.}} = \$0.48/\text{min.}$$

Usage Costs/Mile:

| | |
|---|---|
| Fuel (diesel) @ $.35/gallon and 4 miles/gallon | $0.0875 |
| Oil @ $1.26/gallon and 5,000 miles/gallon | $0.00025 |

Tires:

| | |
|---|---|
| Rear: 4 @ 20,000 miles @ $133 | $0.0266 |
| 2 @ 30,000 miles @ $133 | 0.00887 |
| Repair and Maintenance | 0.0500 |
| Total | $0.173/mile |

| | |
|---|---|
| Total Annual Time Cost/Min. | $0.48 |
| Usage Cost/Mile | $0.173 |

Assuming a 40 mile round trip takes 60 min.,

$6.92 = $0.173/mile x 40 mile

$6.92 ÷ 60 min. = $0.1153/min.

Total cost/minute = $.48 + $0.1153 = $.5953

Assuming 5 tons/truck,

Cost/ton/min. = $.5953 ÷ 5 = $0.119/ton/min.

## Transfer Vehicle Costs

### Capital Costs

| | Cost |
|---|---|
| Transfer tractor | $18,480 |
| Transfer trailer | 22,400 |
| Tires: | |
| Tractor - 8 rear @ $133 | 1,064 |
| 2 front @ $133 | 266 |
| Trailer - 8 @ $133 | 1,064 |
| Transfer Vehicle Cost Less Tires | $38,486 |

### Annual Time Costs

| | |
|---|---|
| Depreciation on tractor less tires over 6 yrs. | $ 3,080 |
| Depreciation on trailer less tires over 6 yrs. | 3,733 |
| Driver's Salary | 19,880 |
| Fringe Benefits @ 25% of salary | 4,970 |
| Interest on transfer vehicle less tires @ 6% | 2,309 |
| Taxes and licenses | 1,639 |
| Insurance | 1,680 |
| Total Annual Time Cost | $37,291 |

Assuming 260 days/yr. and 8 hrs./day:

$$\text{Cost/min.} = \frac{\$37,291}{260 \text{ days} \times 8 \text{ hrs.} \times 60 \text{ min.}} = \frac{\$37,291}{124,800 \text{ min.}} = \$0.299/\text{min.}$$

### Usage Cost/Mile

| | |
|---|---|
| Fuel (diesel) @ $0.35/gallon and 4 mi./gallon | $0.0875 |
| Oil @ $1.26/gallon and 5000 mi./gallon | 0.00025 |
| Tires: | |
| Tractor - 8 rear @ $133 and @ 20,000 miles | 0.0532 |
| 2 front @ $133 and @ 30,000 miles | 0.00887 |
| Trailer - 8 tires @ $133 and @ 20,000 miles | 0.0532 |
| Repair and Maintenance | 0.056 |
| Total Usage Cost/Mile | $0.259 |

Assume that transfer vehicle driving time is 1.25 hrs. for a 40-mile round trip, but one cycle takes 2.00 hrs. Accordingly, there are 45 min. of unproductive time for loading and unloading at $0.299/min. which comes out to: (Assuming a 20 ton load)

(45 min. x $0.299/min.) ÷ 20 tons = $0.67/ton

This will be plotted at zero travel time in Figure C1. The cost of owning and operating the transfer station will be calculated by using the total cost/ton for transfer and hauling at a comparable transfer station operation in Hamilton, Ohio and subtracting the calculated haul cost for this transfer station. The calculated haul cost is the cost per mile per ton multiplied by the number of miles for the haul:

Transfer Vehicle Annual Time Cost = $0.299/min.

Assuming a 40 mile round trip takes 75 min. of road time:

75 min./40 miles = 1.875 min/mile
1.875 min./mile x $0.299/min. = $0.561/mile

Transfer Vehicle Usage Cost/Mile= $0.259/mile

Total haul cost/mile = $0.82/mile

Assuming 20 ton load, ÷ 20 ton

Total haul cost/ton/mile = $0.041

Mileage from transfer site at airport to Mt. Eaton area ≅ 21.9

Total haul cost = cost/ton/mile x miles
= $0.041/ton/mile x 21.9 miles = $ 0.90/ton

Transfer Station Cost = Total cost - Haul cost
= $3.40/ton - $0.90/ton

Transfer Station Cost = $2.50/ton

This cost will also be plotted at zero travel time.

Total cost/ton/minute in travel time:

$$\text{Total usage cost/minute} = \frac{\$0.259/\text{mile} \times 40 \text{ mile}}{75 \text{ min.}} = \$0.138/\text{min.}$$

Total cost/minute = total usage cost/min. + total time cost/min. =
$\$0.138 + \$0.299$
= $\$0.437$/min.
Total cost/ton/min. = $\$0.437/\text{min.} \div 20$ ton = $\$0.022$/ton/min.

| | Cost Per Ton | | |
|---|---|---|---|
| Mins. | $0.119/ton/min. 1-driver;2-collectors Collection Vehicle | $0.022/ton/min. Transfer Vehicle | |
| 10 | 1.19 | 0.22 | +3.17 |
| 20 | 2.38 | 0.44 | +3.17 |
| 30 | 3.57 | 0.66 | +3.17 |
| 40 | 4.76 | 0.88 | +3.17 |
| 50 | 5.95 | 1.10 | +3.17 |
| 60 | 7.14 | 1.32 | +3.17 |
| 70 | 8.33 | 1.54 | +3.17 |
| 80 | 9.52 | 1.76 | +3.17 |
| 90 | 10.71 | 1.98 | +3.17 |
| 100 | 11.90 | 2.20 | +3.17 |

From figure C1, the breakoff point between the collection vehicle and the transfer vehicle is about 33 minutes. Since it was assumed that the collection vehicle could make a 40-mile round trip in 60 minutes, the number of miles that would be traveled in 33 minutes would be:

$$\frac{40 \text{ mile}}{60 \text{ minutes}} \times 33 \text{ minutes} = 22 \text{ miles}$$

This would mean a one-way trip of 11 miles. Therefore, the breakoff point where it becomes more efficient to operate a transfer station rather than a collection vehicle would be 11 miles.

**Source:** [29]

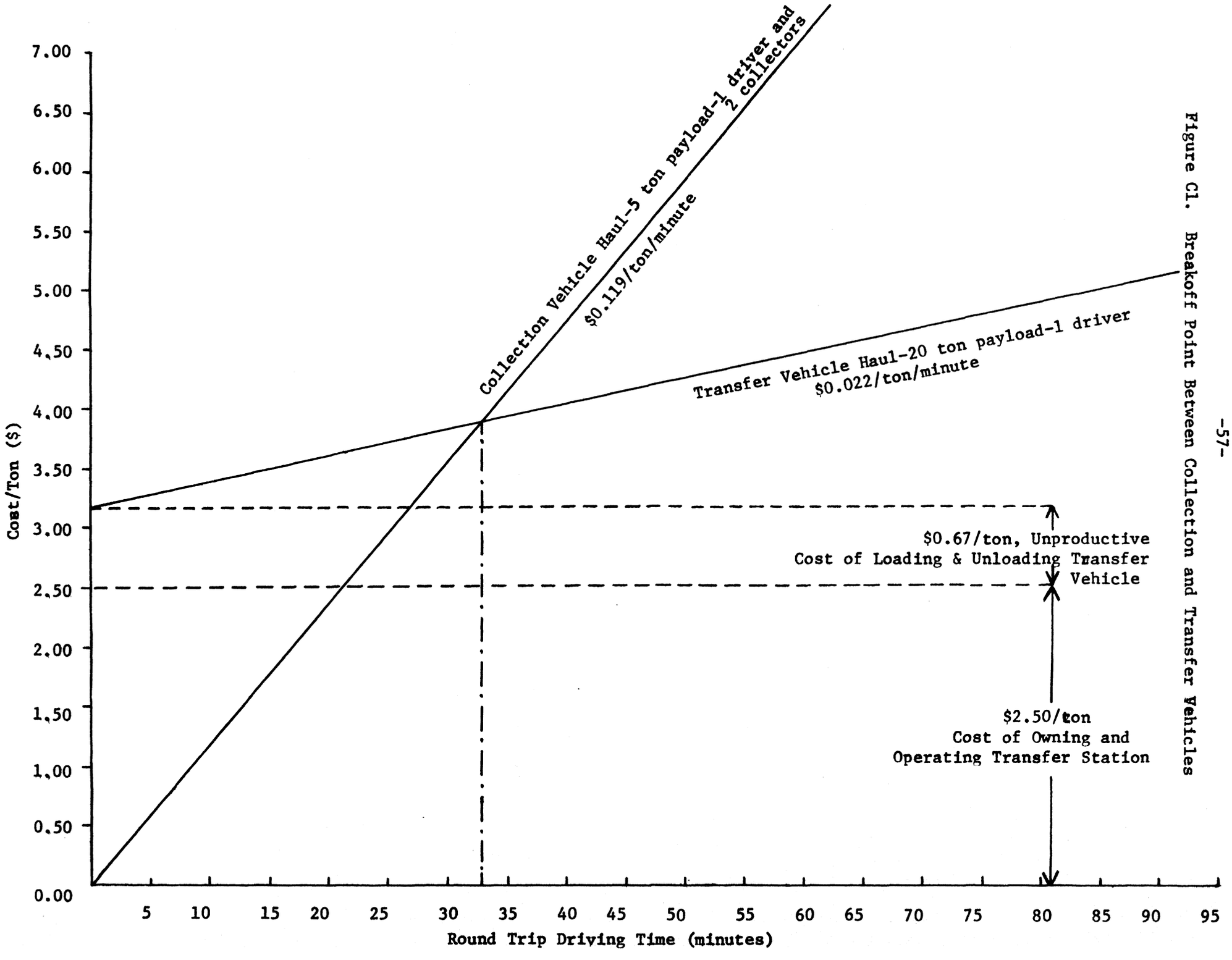
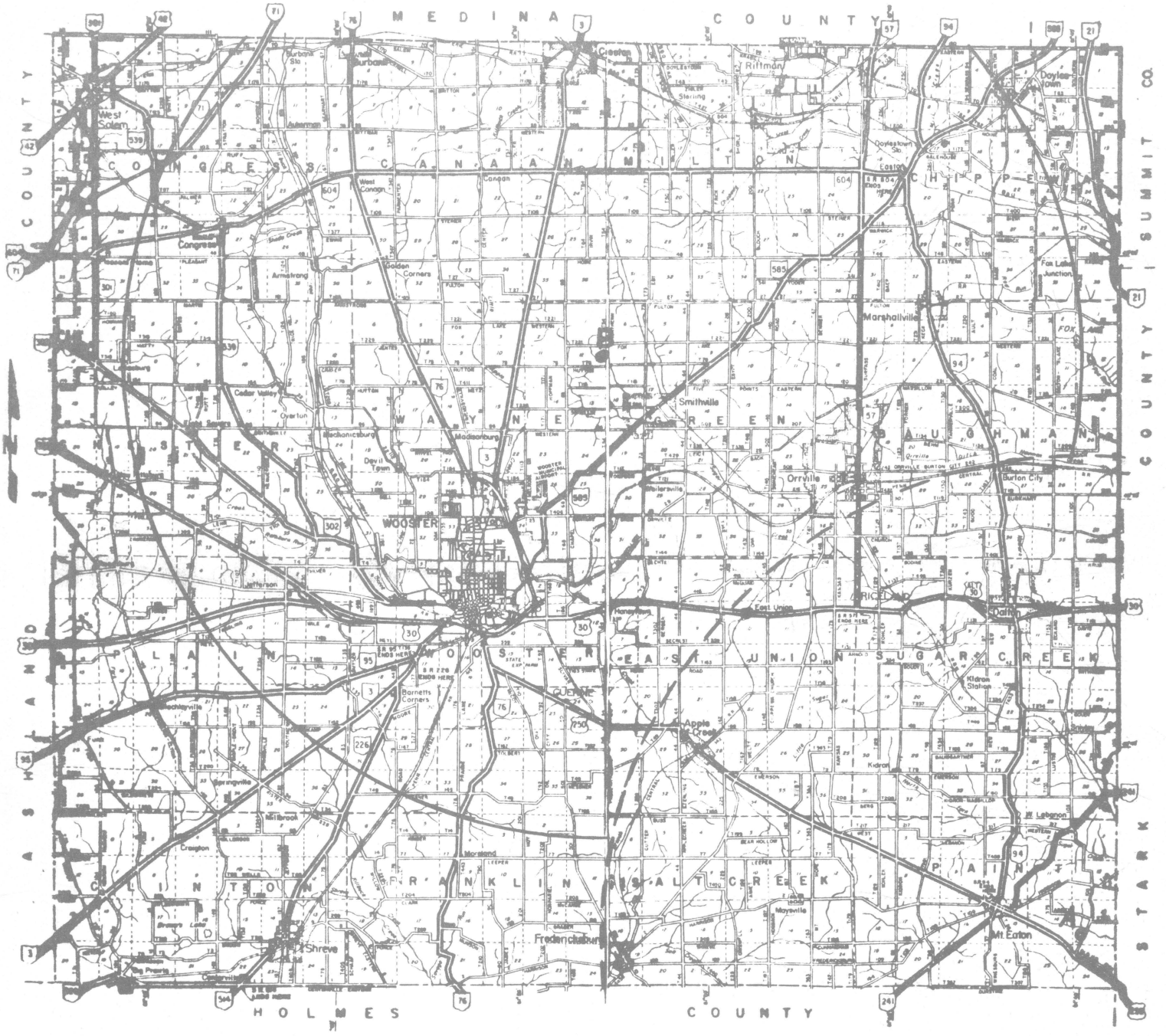



Figure C1. Breakoff Point Between Collection and Transfer Vehicles

Figure C2. Breakoff Points Between Transfer Station at County Airport and Landfill in Mt. Eaton Area




— — — — — Within this circle, waste goes to landfill (A) by packer truck.

——————— Within this circle, waste goes to transfer station at county airport (B) or transfer station in that vicinity.

## Appendix D

Summary

## TRANSFER STATION
## COST ESTIMATING REQUIREMENTS

| *Cost Estimating Item* | *Capital Costs* | *Annual Costs* |
|---|---|---|
| **PREMILINARY ENGINEERING EVALUATION** | | |
| Transfer Station | _____ | _____ |
| Facility Requirements Estimate | _____ | _____ |
| Equipment Requirements Estimate | _____ | _____ |
| Site Requirements Estimate | _____ | _____ |
| (A preliminary engineering evaluation is needed for both large and small transfer stations to establish probable costs. Large transfer station evaluations will also need the following studies.) | | |
| Collection system | _____ | _____ |
| Existing costs | _____ | _____ |
| Improvements costs | _____ | _____ |
| Disposal Site | _____ | _____ |
| Existing costs | _____ | _____ |
| Improvement costs | _____ | _____ |
| Management Procedures | _____ | _____ |
| Existing costs | _____ | _____ |
| Improvement costs | _____ | _____ |
| (The preliminary engineering evaluation should include a comparison of the costs of the total solid waste collection and disposal system with a transfer station against the costs of improving the existing system without a transfer station.) | | |
| **ENGINEERING COSTS** | | |
| *Facility* | | |
| Facility design | _____ | _____ |
| Site Evaluation | _____ | _____ |
| Site Surveys | _____ | _____ |
| Topographic surveys | _____ | _____ |
| Drainage requirements surveys | _____ | _____ |
| Surface water | _____ | _____ |
| Groundwater | _____ | _____ |
| Detailed plans | _____ | _____ |
| Specifications for construction bids | _____ | _____ |
| Construction contracts | _____ | _____ |
| Award procedure | _____ | _____ |
| Administration | _____ | _____ |
| Construction supervision | _____ | _____ |
| Other | _____ | _____ |
| *Equipment* | | |
| Specifications for equipment bids | _____ | _____ |
| Equipment contracts | _____ | _____ |
| Awards procedure | _____ | _____ |
| Administration | _____ | _____ |
| Equipment installation supervision | _____ | _____ |
| Other | _____ | _____ |

Summary

TRANSFER STATION

COST ESTIMATING REQUIREMENTS (Cont.)

| *Cost Estimating Item* | *Capital Costs* | *Annual Costs* |
|---|---|---|
| **ENGINEERING COSTS (Cont.)** | | |
| *Miscellaneous Costs* | | |
| *Contingency Costs* | | |
| (Contingency costs are unforeseen or unanticipated costs resulting from inaccuracies in cost estimating, materials and equipment price changes, increased labor costs, or inflation. Inflation in the United States in 1969 and 1970 approximated 5 percent per annum. Inflation may be expected to significantly affect cost estimates during the fist half of the 1970's.) | | |
| **FACILITY COSTS** | | |
| *Land Acquisition Costs* | | |
| Boundary survey | | |
| Deed preparation | | |
| Transfer costs | | |
| Property costs | | |
| *Land Development* | | |
| Clearing | | |
| Draining | | |
| Ditching | | |
| Roads (access and internal) | | |
| Paved areas | | |
| Parking areas | | |
| Waiting areas | | |
| Fencing | | |
| Landscaping | | |
| Lighting | | |
| Utility and service connections | | |
| Gas | | |
| Water | | |
| Electricity | | |
| Sewer or alternatives | | |
| Other | | |
| *Structures* | | |
| Unloading area | | |
| Ramps | | |
| Docks | | |
| Push pit | | |
| Equipment foundation | | |
| Retaining walls | | |
| Main transfer building | | |
| Foundation | | |
| Floor | | |
| Walls | | |
| Roof | | |
| Lighting | | |
| Heating and ventilating | | |
| Plumbing | | |
| Telephone and/or radio service | | |
| Fire prevention equipment | | |

Summary

## TRANSFER STATION

## COST ESTIMATING REQUIREMENTS (Cont.)

| *Cost Estimating Item* | *Capital Costs* | *Annual Costs* |
|---|---|---|
| **FACILITY COSTS (Cont.)** | | |
| *Structures (Cont.)* | | |
| Weigh station shelter | _____ | _____ |
| Foundation | _____ | _____ |
| Floor | _____ | _____ |
| Walls | _____ | _____ |
| Roof | _____ | _____ |
| Lighting | _____ | _____ |
| Heating and ventilating | _____ | _____ |
| Plumbing | _____ | _____ |
| Telephone and/or radio service | _____ | _____ |
| Fire prevention equipment | _____ | _____ |
| Washing facility | _____ | _____ |
| Foundation | _____ | _____ |
| Floor | _____ | _____ |
| Walls | _____ | _____ |
| Roof | _____ | _____ |
| Lighting | _____ | _____ |
| Heating and ventilating | _____ | _____ |
| Plumbing | _____ | _____ |
| Telephone and/or radio service | _____ | _____ |
| Fire prevention equipment | _____ | _____ |
| Vehicle Maintenance and Housing | _____ | _____ |
| Foundation | _____ | _____ |
| Floor | _____ | _____ |
| Walls | _____ | _____ |
| Roof | _____ | _____ |
| Lighting | _____ | _____ |
| Heating and ventilating | _____ | _____ |
| Plumbing | _____ | _____ |
| Telephone and/or radio service | _____ | _____ |
| Fire prevention equipment | _____ | _____ |
| Office building | _____ | _____ |
| **(Offices may be located in a city hall or county courthouse and not on the site. Costs associated with all office space must be considered when estimating the total cost of a transfer station.)** | | |
| Foundation | _____ | _____ |
| Floor | _____ | _____ |
| Walls | _____ | _____ |
| Roof | _____ | _____ |
| Lighting | _____ | _____ |
| Heating and ventilating | _____ | _____ |
| Plumbing | _____ | _____ |
| Telephone and/or radio service | _____ | _____ |
| Fire prevention equipment | _____ | _____ |
| Miscellaneous Costs | _____ | _____ |
| Contingency Costs | _____ | _____ |
| **(See explanation of Contingency Costs in Engineering Costs Section.)** | | |

Summary

## TRANSFER STATION

## COST ESTIMATING REQUIREMENTS (Cont.)

| *Cost Estimating Item* | *Capital Costs* | *Annual Costs* |
|---|---|---|
| **EQUIPMENT COSTS** | | |
| *Operating Equipment* | | |
| Hoppers | | |
| Compaction units | | |
| Containers | | |
| Roll-on Roll-off | | |
| Other | | |
| Trucks | | |
| Container | | |
| Pickup | | |
| Open dump | | |
| Other | | |
| Tractors | | |
| Highway | | |
| Yard tractors | | |
| Other | | |
| Trailers | | |
| Transfer | | |
| Compaction | | |
| Other | | |
| Solid Waste Moving Vehicles or Devices | | |
| Bulldozers | | |
| Backhoes | | |
| Conveyor systems | | |
| Front loaders | | |
| Overhead cranes | | |
| Push-pit mechanisms | | |
| Other | | |
| Other operating equipment | | |
| *Safety Equipment* | | |
| Fire fighting equipment | | |
| Protection and warning devices | | |
| Other | | |
| *Maintenance Equipment* | | |
| Facility maintenance equipment | | |
| Vehicular maintenance equipment | | |
| Small tools | | |
| Other | | |
| *Administrative Equipment* | | |
| Office equipment | | |
| Office furniture | | |
| Other | | |
| *Miscellaneous Costs* | | |
| *Contingency Costs* | | |

**(See explanation of Contingency Costs in Engineering Costs section.)**

Summary

## TRANSFER STATION
## COST ESTIMATING REQUIREMENTS (Cont.)

| *Cost Estimating Item* | *Annual Costs* |
|---|---|
| **OPERATING COSTS** | |
| *Direct Costs* | |
| (Direct costs include all expenditures that can be identified with, or charged directly to, an individual item of work or piece of equipment.) | |
| Labor | |
| Base salaries or wages | |
| Fringe benefits | |
| Social Security | |
| Vacation and sick leave | |
| Retirement | |
| Insurance | |
| Life | |
| Medical | |
| Unemployment | |
| Workmen's Compensation | |
| Material and supplies | |
| Maintenance | |
| (Maintenance refers to day-to-day or routine upkeep.) | |
| Equipment | |
| Gas | |
| Oil | |
| Diesel fuel | |
| Grease | |
| Tires | |
| Other servicing | |
| Site | |
| Fence maintenance | |
| Roadway and unloading area cleaning and upkeep | |
| Trimming grass, trees, and shurbs | |
| Picking up scattered solid waste | |
| Guarding premises (watchman) | |
| Other | |
| Building | |
| Cleaning | |
| Other | |
| Repair | |
| (Repair refers to major overhauls or extensive replacement or rebuilding of parts or structures.) | |
| Equipment | |
| Site | |
| Building | |
| Other | |
| *Miscellaneous Direct Costs* | |
| *Contingency Costs* | |
| (See explanation of Contingency Costs in Engineering Costs section.) | |

Summary

## TRANSFER STATION
## COST ESTIMATING REQUIREMENTS (Cont.)

*Cost Estimating Item* — *Annual Costs*

### OPERATING COSTS (Cont.)

*Indirect Costs* _____

(Indirect costs include all expenditures that cannot be identified with or charged directly to, an individual item of work or piece of equipment.)

- Materials and supplies _____
- Items manufactured at facility (special tools) _____
- Rent _____
- Taxes (if applicable) _____
- Insurance _____
- Interest _____
- Depreciation (see explanatory note 47, page 35) _____
- Maintenance _____

(Maintenance refers to day-to-day or routine upkeep.)

  - Equipment _____
    - Gas _____
    - Oil _____
    - Diesel fuel _____
    - Grease _____
    - Tires _____
    - Other _____
  - Site _____
    - Fence maintenance _____
    - Roadway and unloading area cleaning and upkeep _____
    - Trimming grass, trees, and shrubs _____
    - Picking up scattered solid waste _____
    - Guarding premises (watchman) _____
    - Other _____
  - Building _____
    - Cleaning _____
    - Other _____
- Repair _____

(Repair refers to major overhauls or extensive replacements or rebuilding of parts or structures.)

  - Equipment _____
  - Building _____
  - Site _____
  - Other _____
- Administrative costs (See explanatory note 46, page 34.) _____
  - Base salaries or wages _____
  - Fringe benefits _____
    - Social Security _____
    - Vacation and sick leave _____
    - Retirement _____
    - Insurance. _____
      - Life _____
      - Medical _____
      - Unemployment _____
      - Workmen's Compensation _____
  - Office Space _____

Summary

## TRANSFER STATION
## COST ESTIMATING REQUIREMENTS (Cont.)

| *Cost Estimating Item* | *Capital Costs* | *Annual Costs* |
|---|---|---|
| **OPERATING COSTS (Cont.)** | | |
| *Indirect Costs (Cont.)* | | |
| Office Space | | _____ |
| Office equipment | | _____ |
| Office supplies | | _____ |
| Office furniture | | _____ |
| Other | | _____ |
| Utilities and services | | _____ |
| Gas | | _____ |
| Electricity | | _____ |
| Water | | _____ |
| Sewer or alternatives | | _____ |
| Other | | _____ |
| Small tools | | _____ |
| Public relations | | _____ |
| *Miscellaneous Indirect Costs* | | _____ |
| *Contingency Costs* | | _____ |
| **(See explanation of Contingency Costs in Engineering Costs section.)** | | |
| **FINANCING COSTS** | | |
| *Bond Costs* | | |
| Preparation Costs | _____ | _____ |
| Sales costs | _____ | _____ |
| Discount costs | _____ | _____ |
| Redemption or interest schedule or annuity costs | _____ | _____ |
| Audit *(Administrative)* costs | _____ | _____ |
| *Other applicable forms of financing and interest costs* | _____ | _____ |
| *Contingency Costs* | _____ | _____ |
| **(See explanation of Contingency Costs in Engineering Costs section.)** | | |

**Source:** [26]

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